Manufacture, Selection and Application

of

Asphalt Roofing and Siding Products

MANUFACTURE, SELECTION AND APPLICATION OF ASPHALT ROOFING AND SIDING PRODUCTS

by

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By Way of Introduction

This is a "how to do it" manual rather than a piece of sales literature. Its purpose is to provide helpful, practical and authoritative information to those who sell and use asphalt prepared roofings, to the end that the ultimate users of these products may get maximum performance for their roofing dollars.

To those engaged in the distribution and sale of these products this book will serve as a dependable guide to good practice in the selection and application of asphalt roofings.

For the man who applies the product there are 67 pages of authoritative text and illustration covering good principles in the application of the various types of shingles and roll roofings. These recommendations, developed by the Engineering Committee of the Asphalt Roofing Industry Bureau, reflect the conclusions of men whose experience in the industry and whose contributions to its techniques cover more than a quarter century.

While not intended primarily as a text book, previous editions have been widely used for that purpose in engineering schools, agricultural colleges, in extension, secondary and vocational schools and in short courses in light construction. This enlarged revised edition will more usefully serve the same purpose.

Grateful acknowledgement is hereby made to the Engineering Committee, to those members of the industry who have read the manuscript and criticized it constructively, and to Mr. Hubert R. Snoke, of the National Bureau of Standards, from whose published work on Asphalt Roofing the Bureau has drawn freely and whose suggestions have been most helpful in the preparation of the text.

TABLE OF CONTENTS

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I. THE ASPHALT ROOFING INDUSTRY

1. POSITION IN THE ROOFING BUSINESS

Since 1893, when the Asphalt Roofing Industry began in a small way to market roll roofings, the public has steadily increased its acceptance of asphalt roofing products to the point where in 1937 approximately 75% of all roofing applied in the United States was produced by this Industry. Raw materials used in the manufacture of asphalt roofing products were not critical during the war years, so that it was possible for the Industry to step up its production. By 1946, according to a report by the U. S. Department of Commerce, Asphalt Roofing amounted to 85.9% of the total. Continued leadership in the roofing field seems assured for asphalt products because of four basic advantages.

2. BASIC ADVANTAGES OF ASPHALT ROOFING

(a) Fire Resistance

Asphalt Roofing will resist the spread of fire due to flying brands; and even though completely consumed in a hot fire, it will not create flying brands to endanger adjacent structures. Its fire resistance is further increased through the application of non-flammable mineral granules, so that fire insurance premiums on buildings covered with Asphalt Roofing are often lower than on buildings roofed with flammable materials in the same community.

(b) Beauty

There is available to the consumer today a wide range of styles, textures, and colors in Asphalt Roofings from which to choose the one best adapted both to personal preference and a harmonicus relation with other elements in the structure. Color of roofs, doors, windows, shutters, trim, and sidewalls can be harmonized by the skillful planner in such a manner as to achieve real distinction.

(c) Versatility

Good design requires that a building shall be functionally adapted for the purpose it is to serve. Each of its elements must contribute to this end. A permanent structure, such as a city office building designed for many years' service, requires a roof that will provide permanent protection with minimum maintenance costs. On the other hand, a temporary structure, such as a contractor's field office shack designed for one or two season's service, need provide only temporary protection, maintenance being of negligible importance. Yet there is an economical type of Asphalt Roofing Product ideally adapted not only to these wide extremes, but also to the many types of buildings that range between them, both in

cities, in towns, and on the farm. This is true, not only where new construction is involved but also for all kinds of reroofing or maintenance work. No other roofing material possesses such great versatility.

(d) Economy

Factors which contribute to economy in the use of Asphalt Roofing Products are:

(1) Low first cost of the product itself.

(2) No necessity for painting or staining to obtain desired color effects.

(3) Low cost of transportation due to widespread distribution of manufacturing points throughout the country.

(4) Low cost and ease of application and maintenance.

3. INDUSTRY MANUFACTURING FACILITIES

Measured in terms of investment and production facilities, the Asphalt Roofing Industry adds up to an exceedingly stable enterprise of national scope and significance. Building materials manufacturers have a heavy investment in some 145 asphalt roofing plants strategically located throughout the United States. Over a third of these plants came into existence since 1930, during a period characterized in part by the worst business depression this country has ever seen. This unusual development was possible for the one very good reason that the Industry was able to meet a real and insistent demand for a basic need, -- substantial roof protection in a tough climate at a low cost. The size of the investment, the widespread distribution of production facilities, and a record of almost phenomenal performance under difficult economic conditions is the public's assurance of the Industry's present responsibility and future progress.

II. RAW MATERIALS

Figure 1 is a chart showing how raw materials are used to make finished Asphalt Roofing Products.

Rag, wood, and other cellulose fibers are processed into a dry felt, which is then saturated and coated with asphalt, and surfaced with selected mineral aggregates appropriate to the finished product. These may be smooth roll roofings on which mica and talc are spread, or they may be so-called "mineral surfaced" products, such as rolls or shingles, surfaced with slate, stone, or synthetic granules.

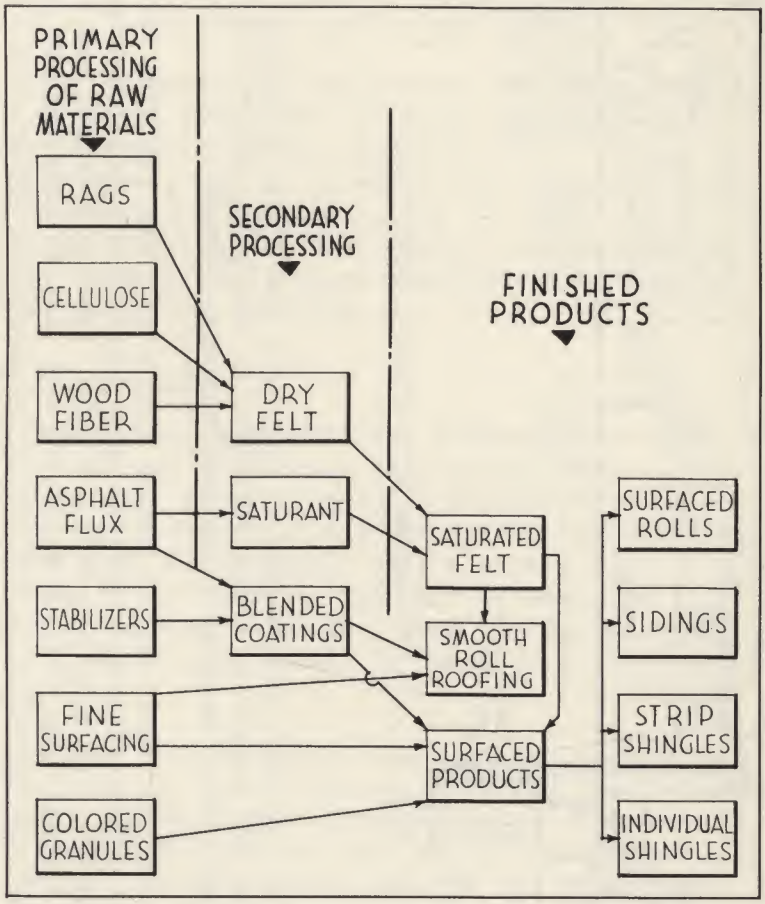


Fig. 1 - Processing Chart for Asphalt Roofing Products; From Raw Materials to Finished Roofing.

Asphalt Flux, described in more detail later, is used to make certain roofing grades of asphalt known in the trade as "saturants" and "coatings", products of secondary processing. It is in these forms that the asphalt is combined with the dry felt in the manufacture of Asphalt Roofing.

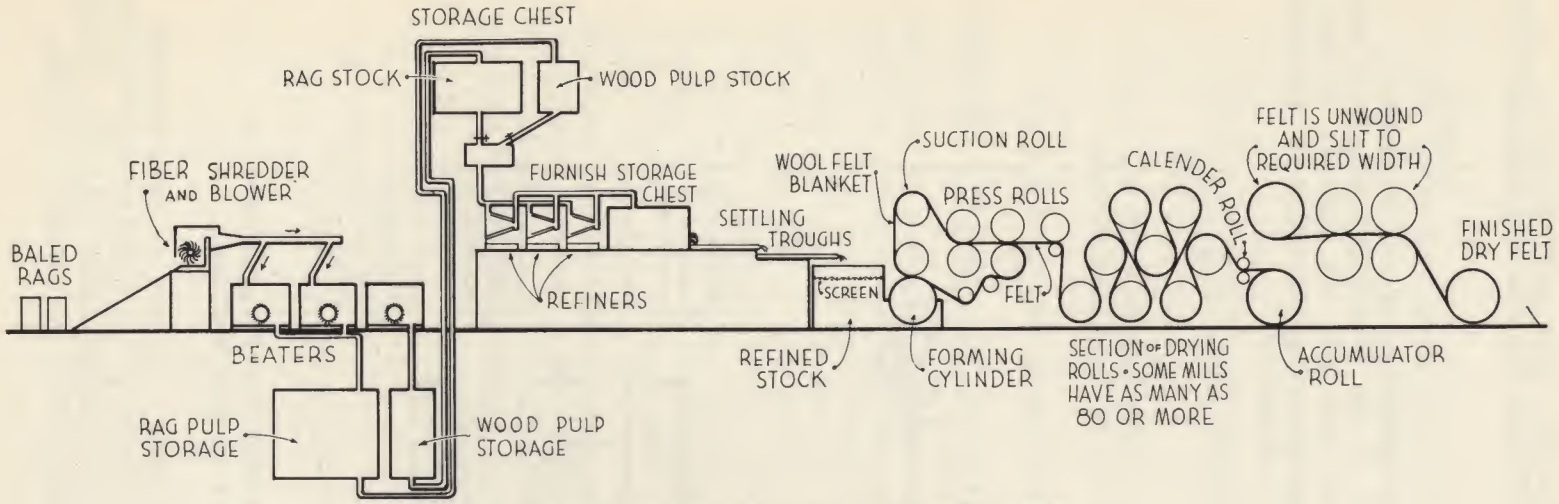


Fig. 2 - Flow Diagram of a Typical Felt Mill.

1. DRY FELT

Dry Felt is made from various combinations of rag, wood and other cellulose fibers blended in such proportions that the resulting characteristics of strength, absorptive capacity and flexibility will be as required to make an acceptable roofing product.

The manufacture of felt is really an art rather than a science. To know exactly the proportions of the various ingredients necessary to meet prescribed specifications requires long experience on the part of the mill operator. Weight, tensile strength and flexibility are specified which will enable the felt to withstand any strains which may be placed upon it in the manufacturing process to which it will later be subjected in the roofing plant, and to enable it to absorb from $1\frac{1}{2}$ to 2 times its weight in asphalt saturants.

Roofing Felt is made on a machine very similar to a paper machine. (See Fig. 2). The fibers are first prepared by separating them in beaters with water, and then mixed to the desired formula before being formed, pressed and dried into felt.

Felt comes off the end of the machine in a continuous wide sheet from which it is cut into specified widths and wound in rolls from four to six feet in diameter and weighing up to a thousand pounds each. It is specified as to weight in terms of pounds per 480 sq. ft. This is known as the "felt number" and ranges from 21 to 75.

2. ASPHALT

For 5,000 years Asphalt has been used by men as a preservative, waterproofing and adhesive agent. It was used by the Babylonians to waterproof baths and as a pavement. The Egyptians used it to preserve their mummies. Throughout the Middle Ages, Asphalt was in common use in Europe. One of the largest natural deposits was discovered by Columbus on the Island of Trinidad in the British West Indies during his third voyage in the Year 1498.

The material used today in the manufacture of Asphalt Roofing is obtained mostly from the petroleum industry. It is a product of the fractional distillation of crude oil that occurs toward the end of the distilling process, and is known to the trade as "Asphalt Flux". Asphalt Flux is sometimes refined by the oil producer and delivered to the roofing manufacturer in conformance with the manufacturer's specifications. Many of the larger manufacturers, however, purchase the flux and do their own refining.

(a) Saturants and Coating

The preservative and waterproofing characteristics of asphalt reside very largely in certain oily constituents. Therefore, in the manufacture of roofing it is desirable to construct the body of the sheet of highly absorbent felt impregnated or saturated to the greatest possible extent with a type of oil-rich asphalt known as "saturant", and then to seal the saturant in with an application of a harder, more viscous "coating asphalt" which itself can be protected, if desired, by a covering of opaque mineral granules.

The asphalt used for saturants and coatings is prepared by processing the flux in such a way as to modify the temperature at which it will soften. The softening point of saturants varies from 100° to 160° F, whereas that of the coating runs as high as 260° F. Asphalt chemists have learned how to regulate this characteristic so that it can be adapted most effectively to resist the temperatures usually found on roofs.

3. MINERAL STABILIZERS

It has been found that coating asphalts will resist weathering better and be more shatter-and shock-proof in cold weather if they contain a certain percentage of finely divided minerals called "stabilizers".

The following are among the materials which have been used as stabilizers: Silica, Slate Dust, Talc, Micaceous Materials, Dolomite, and Trap Rock.

Experience has shown that when a stabilizer of the right type is used in the proper amount, the life of the product in service can be very materially increased.

4. SURFACINGS

(a) Fine Minerals

Finely ground minerals are dusted on the surface of roll roofing and shingles for the primary purpose of preventing the convolutions of the roll from sticking together after it is wound, and of preventing shingles from sticking together in the package. Materials most largely used for this purpose are Talc, Mica, and Micaceous Talc. It is not a permanent part of the finished product and will gradually disappear from exposed surfaces after the roofing is applied.

(b) Coarse Minerals or Granules

Mineral Granules are used on certain roll products and on shingles for the following principal reasons:

(1) They protect the underlying asphalt coating from the impact of light rays. Therefore, they should be opaque and dense.

(2) By virtue of their mineral origin, they increase the fire resistance of the product.

(3) They provide for a wide range of colors and color blends, thereby increasing the adaptability of surfaced asphalt roofings to different types of buildings, and contributing to public acceptance.

(4) They provide a good wearing and weathering surface.

The materials most frequently used for mineral surfacing are: Natural Slate, Quartz, Trap Rock and Slag. Some surfacings are manufactured from clay which is subjected to a ceramic treatment, thus producing synthetic granules.

III. MANUFACTURE OF ROOFING

I. SEQUENCE OF EVENTS IN THE PLANT

Figure 3 represents diagramically how raw materials are processed into finished roofing products. The principal steps occur in regular sequence as follows, the whole process being continuous: -

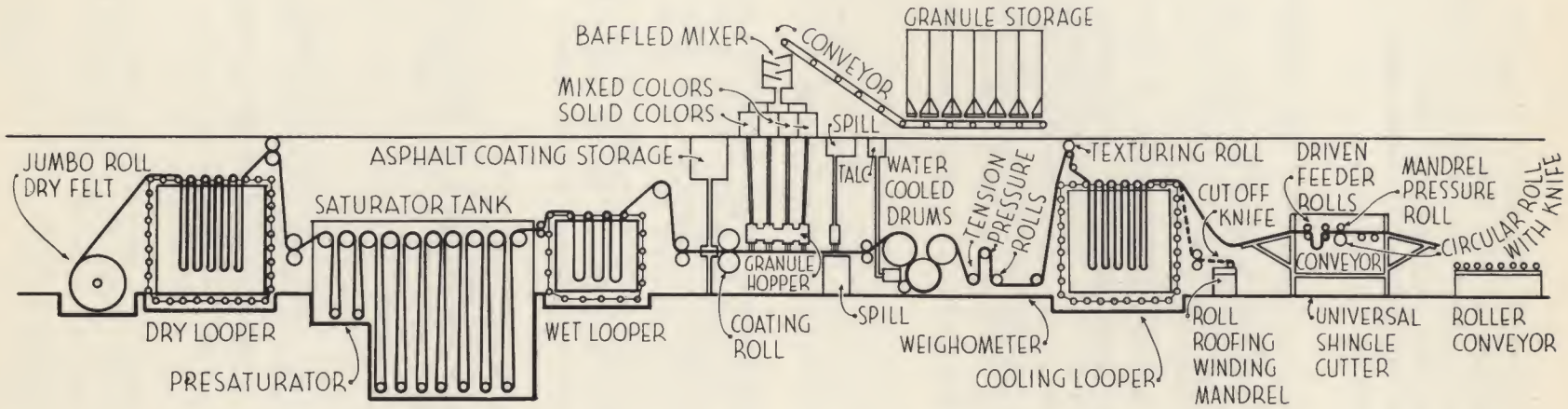


Fig. 3 - Flow Diagram of a Typical Roofing Plant

(a) Dry Looper

A roll of dry felt is installed on the felt reel and is unwound onto the "dry looper". The looper acts as a reservoir of felt material that can be drawn upon by the machine as circumstances demand, eliminating stoppages, such as when a new roll must be put on the felt reel, or when imperfections in the felt must be cut out.

(b) Saturation of Felt

The felt is first subjected to a pre-saturating process which is designed to eliminate moisture that might have accumulated in storage. Then the felt is filled as completely as possible with hot asphalt.

The objective is to saturate the fibers completely and to fill all the small spaces between them with asphalt saturant.

(c) Wet Looper

At the completion of the saturating process an excess of saturant usually remains on the surface of the sheet. It is therefore held for a time on a wet looper so that the natural shrinkage of the asphalt, upon cooling, will cause the excess to be sucked or drawn into the felt, resulting in a very high degree of saturation.

(d) Coater

After saturating, the sheet is carried to the "coater" where the coating asphalt is applied to both the top and bottom surfaces. The amount is regulated by "coating rolls" which can be brought together to reduce the amount, and separated to increase it.

It is at this point that the finished weight of the product is controlled by the machine operator. Long experience enables him to maintain uniform production by delicate adjustments of the control mechanism. Many roofing machines are equipped with automatic electric eye scales which weigh the sheets in the process of manufacture and warn the operator when the material is running over or under weight specifications.

(e) Mineral Surfacing

When smooth roll roofing is being made, talc or mica is applied to the underside by spreading and pressing through a press roll.

When mineral surfaced products are being prepared, granules of specified color or color combinations are added from a hopper and spread thickly on the hot coating asphalt. The sheet is then run through a series of press and cooling rolls or drums. In order to insure proper embedment of the granules, the sheet is subjected to controlled pressures which force the granules into the coating to the desired depth.

(f) Texture

At this point some products are textured by being pressed by an embossing roll which forms a pattern in the surface of the sheet.

(g) Finish, or Cooling Looper

The sheet is now ready to go into the finish looper. The primary function of this looper is to cool down the sheet to a point where it can be cut and packed without danger to the material.

(h) Shingle Cutter

When shingles are being made, the material is fed from the finish looper into the shingle-cutting machine. The sheet is cut by a cutting cylinder against which pressure is exerted by an anvil roll as the sheet passes between them. The cylinder cuts the sheets from the back or smooth side. After the shingles have been cut they separate into units which accumulate in stacks of the proper number for packaging. The stacks are moved either to manually operated or to automatic packaging equipment where the bundles are prepared for warehousing or shipment.

(i) Roll Roofing Winder

When roll roofing is being made, the sheet is drawn from the finish looper to the roll roofing winder. Here it is wound on a mandrel which measures the length of the material as it turns. When sufficient has accumulated, it is cut off, removed from the mandrel and passed on for wrapping. After packaging, the rolls are assembled for warehousing or shipment.

2. CONTROLS AND INSPECTIONS

From the time the dry felt enters the saturator until the finished products leave the shingle cutters or winding mandrels, the material is rigidly inspected to insure conformance with specified standards. Some of the important items checked are:

(a) Saturation of felt to determine quantity of saturant and efficiency of saturation.

(b) Thickness and distribution of coating asphalt.

(c) Adhesion and distribution of granules.

(d) Inspection of finished product before and after it is packaged for weight, count, size, coloration and other characteristics.

3. WAREHOUSING

Certain rules are observed in storing finished materials to insure that they will leave the warehouse in just as good condition as when they entered. Some of the most important are as follows:

(a) Store roll goods on end in an upright position. If several tiers are to be stored one on top of the other, place boards between the tiers to prevent damage to the ends of the roll.

(b) Store bundles at such heights that pressure on the bottom will not cause bleeding or discoloration; that is, force asphalt through the granules to the surface of the shingle in extra warm weather. If the material is to be stored for any length of time, heavy bundles (2 per square) should not be stored higher than 5 bundles deep. Lighter weight bundles (3 per square) may be stored 7 to 8 bundles deep in the same circumstances. Observe manufacturers' recommendations for specific styles.

(c) Arrange stock so there is ample space for the passage of trucks and other conveying equipment. Damage by collision with moving equipment is thereby eliminated.

(d) Rotate stock by moving first out of storage the material which has been held the longest.

All of the above precautions should be observed by jobbers and dealers in their warehouses.

IV. RESEARCH

The price of continued public acceptance of any commodity is constant attention to maintenance of adequate service standards, and constant effort to improve the product so that service standards can be raised. Most manufacturers in the Asphalt Roofing Industry, realizing the soundness of this philosophy, maintain research staffs and provide them with laboratories adequate to enable them to set up proper manufacturing controls and to search out the answers to problems arising from field experience with the products. The constant aim of the research organization is to improve the control over and quality of raw materials, to improve and simplify manufacturing methods and procedures, and to cooperate closely with the factory and sales organization in providing solutions to problems presented by salesmen, distributors and customers.

Through the agency of the Asphalt Roofing Industry Bureau company research departments pool such problems as are of industry-wide significance and work together in a research committee. This committee, in addition to meeting for discussing problems of mutual scientific interest to its members, also administers the work of a National Bureau of Standards Fellowship, which has been supported by the Industry since 1926. The Bureau's Research Fellow is engaged with such problems as the determination of the value of mineral stabilizers in coating asphalts; the effect of the use of various kinds of fibers on the formation and other characteristics of roofing felt; the characteristics of the various constituents of asphalt to determine which ones contribute most to satisfactory weathering, and to what extent; developing procedures for making accelerated weathering tests of roofing samples by means of special laboratory equipment, and the like.

Fundamental research of this nature has enabled the Industry to make a very real contribution to our American standard of living by placing at the disposal of the average citizen the benefits of lasting protection from the weather at a low cost. In this sense the development of asphalt roofing parallels that of the low-priced automobile which was responsible for making inexpensive transportation so generally available.

V. TYPICAL ASPHALT ROOFING PRODUCTS

Asphalt Roofing and Siding Products made on a felt base may be classified broadly in three groups: (1) Saturated Felts, (2) Roll Roofing and Roll Sidings, and (3) Roofing and Siding Shingles.

(1) SATURATED FELTS

Saturated Felts, used as underlayment for shingles, for sheathing paper, and for laminations in the construction of built-up roofs, consist of dry felt impregnated with an asphalt or coal tar saturant, but otherwise untreated. They are made in different weights, the most common being No. 15 and No. 30, weighing approximately 15 pounds and 30 pounds per square (*), respectively.

(2) ROLL ROOFING AND SIDINGS

Roll Roofing is made by adding a coating of a more viscous, weather-resistant asphalt to a felt which has first been impregnated with a saturant asphalt. Some roll roofings are surfaced with mineral granules to produce a wide range of colors. Some styles are furnished in split rolls designed to give an edge pattern when applied to the roof. Mineral surfaced rolls are also embossed to simulate brick or stone for use as sidings.

(3) SHINGLES

Shingles are all surfaced with mineral granules. There are many patterns, some individual and some in strips 36" long. The strip shingles, and some individual shingles both rectangular and interlocking are intended for new work as well as for reroofing. Other lighter weight individual shingles are designed primarily for reroofing. Some individual shingles are arranged with interlocking devices to secure each course to the course below and others are stapled to insure tight substantial anchorage.

Products which are typical of these three classes are listed and described in Table 1, Pages 13 and 14. The table is set up in 9 columns arranged to show the important characteristics of the products.

Column 1 - Illustrates and names the product.

Column 2 - Indicates the weight of the product per square on the roof.

Column 3 - States the number of packages required to cover one square. This value will enable the estimator to compute the amount of material for any given area.

(*) A "Factory" square of roofing equals 108 sq. ft. of material, as it comes from the machine. A "sales" square of roofing is that amount which, when applied, will cover 100 sq. ft. of roof surface.

Columns 4 and 5 - State the over-all dimensions of one unit of the product in length and width.

Column 6 - States the number of shingles required to cover one square. When the speed with which the average workman can apply the shingle is known, this figure will be a help in computing the labor cost of a job.

Column 7 - Indicates the side lap -- the distance in inches which horizontally adjacent elements of roofing overlap each other.

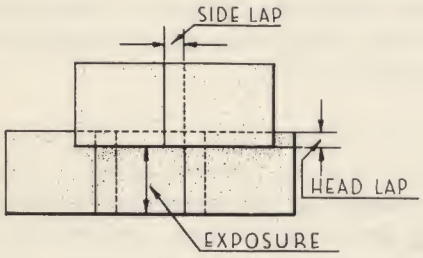


Fig. 4

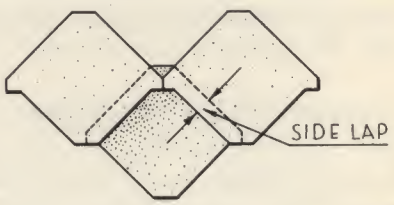


Fig. 5

Column 8 - Indicates the headlap. Headlap is defined as the shortest distance between an exposed edge of a shingle and the roof deck, measured at right angles to the eaves or parallel to the rake. In the case of the three tab square butt shingle, it is the distance from the top of the cut-out of one course to the top edge of the strip in the course next below. See Figures 4 and 6.

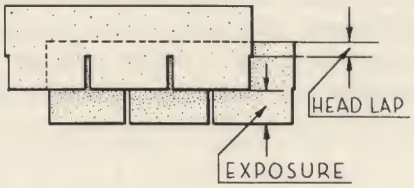


Fig. 6

Column 9 - Indicates the exposure of the unit. Exposure is the distance between exposed edges of adjacent courses measured at right angles to the eaves. See Figures 4 and 6.

The data given in Table I is typical but it should be understood that there may be individual variations among the products of different manufacturers. Particularly is this true in the case of individual shingles and to a somewhat less extent with strip shingles.

TABLE I - TYPICAL ASPHALT ROOFING PRODUCTS

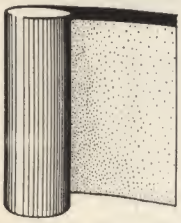
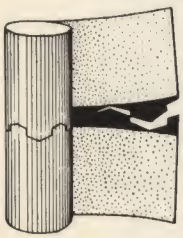
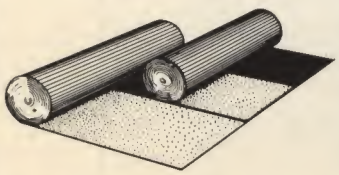
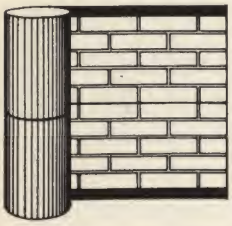
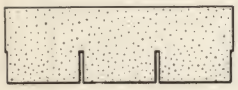
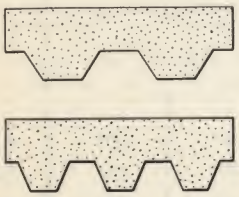
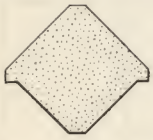
1	2	3	4	5	6	7	8	9
PRODUCT	Wt. Per Square Applied	Packages Per Square	Length	Width		Side or End Lap	Headlap	Exposure
 Asphalt Saturated Felt	15 lb. 30 lb.	1/4 1/2	144' 72'	36" 36"		4" 4"	2" 2"	34" 34"
 Mineral Surfaced Roll	90 lb. 93 lb. 95 lb.	1.0 1.075 1.15	36' 36' 36'	36" 36" 36"	Exp. Conc. Conc.	4" 6" 6"	2" 3" 4"	34" 33" 32"
 Smooth Roll	65 lb. 55 lb. 45 lb.	1 1 1	36' 36' 36'	36" 36" 36"		4" 4" 4"	2" 2" 2"	34" 34" 34"
 Pattern Edge Roll	105 lb. 105 lb.	1 1	42' 48'	36" 32"			2" 2"	16" 14"
 19" Selvage Double Coverage	144 lb. 140 lb.	2 2	36' 36'	36" 36"	Cold Hot		19" 19"	17" 17"

TABLE I (CONT'D) TYPICAL ASPHALT ROOFING PRODUCTS

1	2	3	4	5	6	7	8	9
PRODUCT	Wt. Per Square Applied	Packages Per Square	Length	Width	Shingles Per Square	Side or End Lap	Headlap	Exposure
 Roll Brick Siding	105 lb.	1	43'	31"			1-5/8"	13-7/8"
 3 Tab Square Butt Strip Shingle	210 lb. 262 lb.	2 or 3	36" 36"	12" 12"	80 100		2" 4"	5" 4"
 Two and Three Tab Hex Strip Shingle	167 lb.	2	36"	11-1/3"	86		2"	4-2/3"
 Individual Lock-Down	135 to 138 lb.	2	16"	16"	82	$2\frac{1}{2}$"		
 Giant Ind. American	325 lb.	4	16"	12"	226		6"	5"
 Dutch Lap	162 lb.	2	16"	12"	113	3"	2"	10"

TYPICAL ACCESSORIES

1. COATING AND CEMENTS

There are a number of liquid and plastic asphalt products that are used as adhesives, as coatings, and in flashings. They may be classified as follows:

(a) Coatings
- (1) Asphalt Coatings
- (2) Roof Cements
- (3) Quick Setting Cements

Coatings may be either liquid bitumen with nothing added, or they may have asbestos fibers admixed. Some are pure asphalts which have been thinned or "cut back" with a petroleum solvent such as naptha. Others are asphalt-water emulsions which can be thinned if desired, with water. Emulsions must be stored where they will not freeze in cold weather; and they must be used at times when they will not be rained on for a period of 24 hours or more after being applied.

Asphalt coatings are made in several consistencies. The heavy material is used to resurface old smooth surfaced built-up roofs and smooth roll roofings that have become weathered. They are also valuable for use on metal roofs where they check corrosion. As a more fluid product, coating asphalt is used as a temporary water-proofing agent on concrete walls above grade. It is prepared in this form and marketed as an "asphalt primer". Primers are frequently used wherever a firm bond is required between old roofing felts and new material being applied in the repair of built-up roofs.

(b) Roof Cement

This material is generally called "plastic cement" and is made from either an asphalt or coal tar base. Because it is thick and putty-like in consistency, and because its elasticity permits of expansion and contraction under changing temperatures without cracking or crumbling, it is particularly well adapted for use in flashing around chimneys and other roof openings, as well as for sealing or cementing down shingles and roofing along valleys and rakes. It is sufficiently plastic to make application with a trowel or caulking gun easy. Like coatings, plastic cements are "cut backs" of pure asphalt, generally mill-mixed with asbestos fiber.

(c) Lap Cement

This is liquid asphalt with certain materials added which augment the adhesive characteristics of the mixture. It is used to make a watertight bond between the laps of roll roofing.

(d) Quick Setting Lap Cement

This is an asphalt material held in liquid suspension with high-grade quick drying solvents. It has exceptional bonding and adhesive qualities in addition to being fast setting. It is manufactured in both brush and trowel consistency.

The brush consistency is recommended in the application of double coverage roll roofing when the 19" selvage edge is both saturated and coated. The knife grade is used in sealing laps on blind-nailed roll roofing and for sealing down the tabs of shingles and split rolls. It is not recommended for use where it will be exposed to the weather.

2. ROOFING TAPE

Some manufacturers make a roofing tape of cotton fabric saturated with asphalt. It is available in varying widths from 4" to 36", and comes in rolls containing 36' -0". It is used with coatings and plastics for flashing, and in patching seams, breaks, and holes in metal and composition roofs.

3. NAILS AND FASTENERS

Nails used in applying asphalt roofings are large-headed, sharp-pointed, hot galvanized (or equivalent) steel or aluminum nails with barbed or otherwise deformed shanks.

Gauge and Head

Roofing nails should be made of 11 or 12 gauge wire, the heads to be 3/8" to 7/16" in diameter.

Length

Nails should be long enough to penetrate through the roofing material, and at least 3/4" into sound wood deck lumber. This ordinarily requires that they be of the lengths indicated in Table II for the purposes stated.

TABLE II - Recommended Nail Length

Purpose	Nail Length
Roll roofing on new deck	1"
Strip or individual shingles - new deck	1-1/4"
Reroofing - all products	1-3/4"

Number

The number of nails required for each product is specified in the application direction sheet provided by the manufacturer.

When placed on 2" centers in applying roll roofing, 252 nails per square are needed. On 3" centers the number required is 168 per square.

Fasteners for Special Deck Materials

When gypsum products, concrete plank and tile, fiber board, or similar unusual materials other than wood are used for the roof deck, special fasteners and/or details for fastening will be required to provide adequate anchorage for the roofing. In such cases it is recommended that the specifications of the manufacturer of the deck materials be followed.

VI. PRODUCT SELECTION

Wide diversification of asphalt roofing styles makes it possible to satisfy every roofing requirement. There is a suitable product for every condition and purpose. Beauty and wide choice of colors, texture and pattern provide the designer with maximum opportunity for expression. Fire resistance, with its resulting insurance savings, together with the low initial cost and simplicity of application makes asphalt roofings truly economical and adaptable.

Asphalt roofings are made in weights varying from 45 lb. to 325 lb. per square on the roof. It is generally true that the heavier the roof the longer will be its life in service. Therefore, the heavier roofings, such as strip or individual shingles, are best adapted for permanent structures having sloping rather than flat pitches; such as dwellings both in town and country, and most major farm service buildings. Lighter weight roofings of the roll type are well adapted for use on structures such as summer cottages, small farm service buildings, garages and inexpensive temporary storage or shop structures.

But it must be recognized that there is no one kind of asphalt roofing that is best for any particular building under all circumstances. Especially is this so on the farm where building types are so numerous and conditions so diverse. The style of roof selected for the house may, and perhaps should, affect the choice of roof for all other buildings, large or small, that are grouped together in the same farmstead. Uniformity of appearance is important in a group. For instance, a poultry laying house or machine storage shed located near the dwelling or adjacent to major service buildings will rightly call for a roof which conforms architecturally, whereas a more inexpensive roll product might be quite suitable if the building is in an isolated location.

Basically, of course, the important thing is to select the product which will provide adequate protection for the building and its contents with a minimum of maintenance cost and then to apply it properly.

The table on the next page, listing a number of the more important town and farm buildings, indicates various types of asphalt roofing products which, under varying circumstances, might be considered suitable. There are circumstances where practically every one of the varied products might be appropriate for a barn, poultry house, hog house, milk house, or machine shed and shop.

Structure	90 lb. Roll	65 lb. Roll	Pattern Edge Roll	19" Selvage	Individual Giant	Hex Strips	Square Butt Strips	Staple & Lock Down	Dutch Lap & Reroofer
Large Suburban Home			x		x	x	x	x	x
Small Home			x		x	x	x	x	x
Prefabricated Home			x		x	x	x	x	x
Farm Home			x		x	x	x	x	x
Garage	x	x	x	x		x	x	x	x
General Pur se Barn			x	x	x	x	x	x	x
Dairy and Beef Cattle Barns	x		x	x	x	x	x	x	x
Hay Barn	x		x	x		x	x	x	x
Hog Farrowing House	x	x	x	x		x	x	x	x
Movable " "	x	x				x	x	x	
Poultry Laying House	x	x	x	x	x	x	x	x	x
Brooder House	x	x	x	x		x	x	x	
Machine Shed & Shop	x	x	x	x	x	x	x	x	x
Grain Storage (Small)	x	x		x	x	x	x	x	
Milk House	x	x	x	x	x	x	x	x	x

Pitch Limitations

Very important in the selection of roofing for any specific job are the limitations imposed by "pitch" or slope of the roof deck. Shingle type roofings are not adapted for flat or low slope roofs, whereas sheet types can be used for all slopes.

Pitch limitations are indicated by the Chart (Fig. 7). Any shingle can safely be used on roofs with slopes of 4" rise or more per horizontal foot.

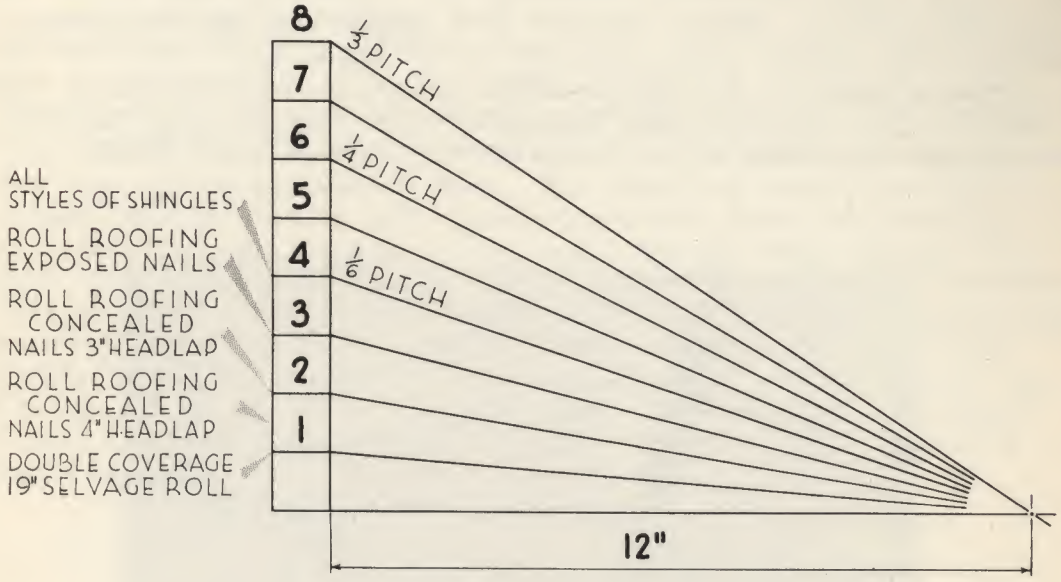


Fig. 7 - Minimum pitch requirements for different Asphalt Roofing Products.

It is safest to use roll roofings on roofs with a pitch of more than 1" per foot. The lowest pitch recommended for roll roofing when the exposed nail method is used is 3" per foot. The concealed nail method of application, when providing a 3" headlap, can be used when the pitch is as low as 2", and if a 4" lap is used, the pitch may safely run as low as 1-1/2". The only roll product that is recommended as being suitable for a 1" pitch is the 19" double coverage roof, while only a properly specified built-up (laminated) roof should be used when the pitch is less than 1" per foot.

VII. APPLICATION OF ASPHALT ROOFING PRODUCTS

Asphalt roofing products will serve out their full span of usefulness only when they are correctly and carefully applied. There are certain fundamentals which must be considered. These lie in three categories:- those having to do with (1) decks, (2) flashings, and (3) application of the materials on the roof.

A number of roofing troubles are caused by defects in the deck. If the deck is not rigid, movements resulting from instability may affect the lay of the roofing. Poorly seasoned deck lumber may warp and cause cocking of the shingle tabs or wrinkling and buckling of roll roofing. An extreme example of what green lumber can do to roll roofing is shown in Fig. 8. Here the deck sheathing warped and tore the roofing which was subsequently blown off of a considerable area by high winds.

Courtesy of War Department

Fig. 8 - Effect of warping of green deck lumber on roll roofing, especially when wide boards are used.

An effect similar to that produced by green lumber has frequently resulted from lack of proper ventilation of the attic space under the roof deck. In cold weather construction, particularly when interiors are being plastered or when plaster is drying, a positive circulation of air through the building should be maintained. This can usually be accomplished by opening one or more windows in the basement and/or first floor, and by opening one or more attic or second floor windows on the opposite end or side of the building. Such circulation is required to remove the moisture-laden air from within the building, thereby decreasing the danger of condensation on the under side of or within the roof sheathing.

It is also important that the attic space be properly ventilated to minimize condensation of moisture after the building is completed and in use. Frequently moisture vapor from the lower stories, rising to the attic will be chilled below its dew point and will condense out on the under side of the roof deck, causing the sheathing boards to warp and buckle sufficiently to disturb the lay of the roofing. To avoid this, louvered openings should be constructed high up under the eaves in the gable ends or at such other locations as will insure adequate venting. Such louvers should have a total effective area equivalent to 1/2 square inch for each square foot of attic floor space.

1. DECK CONSTRUCTION AND REPAIR

Wood decks should be made from well seasoned T & G sheathing, not over 6" nominal width. Wider sheathing boards will shrink in width under some circumstances enough to buckle any flexible roofing material that may be applied to them. The sheathing should be tightly matched, and secured to each supporting rafter with two 8d nails, one driven through the edge of the board and the other through its face. Badly warped boards, or those containing excessively resinous areas or loose knots should be rejected. Any such defects appearing after the sheathing is applied should be covered with sheet metal patches before the roofing is placed. Galvanized iron, painted tin, zinc or copper, having a thickness approximately equal to 26 gauge is good for this purpose. Fig. 9 illustrates these features of a good wood deck.

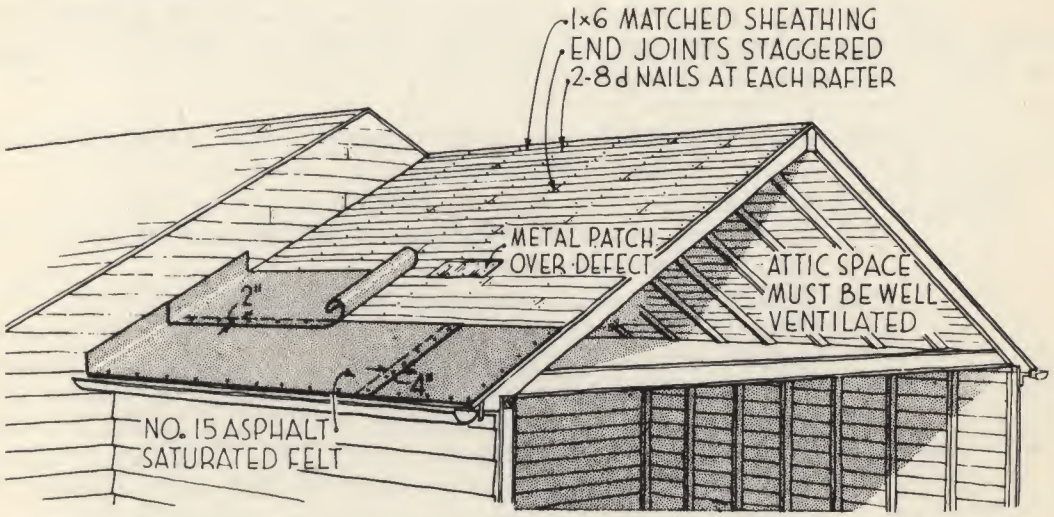


Fig. 9 - Essential features of a satisfactory wood roof deck.

After the deck is completed it should be protected from dampness by an underlayment of asphalt saturated felt not heavier than 15 lb. Do not use a coated product such as smooth roll roofing for this purpose. Coated products are usually good vapor barriers and could cause an accumulation of moisture of frost between the deck and the shingle underlayment.

Plywood Decks should be ½" thick or over, either three or five ply, the maximum center spacing between supporting members being 24".

The units should be applied so that the outer ply runs at right angles to the supporting members. Edge and end joints should be tightly fitted together, and end joints in adjacent courses should be staggered. 6d nails should be used to secure the units to the supporting members at 6" intervals or closer.

The design of the eaves, rake, ridge, or any openings through the deck should be such that the plywood will not be exposed to the weather either on a surface or on an edge.

2. DECK TREATMENT FOR REROOFING

In most localities when a reroofing job is under consideration, a choice must be made between removing the old roofing or permitting it to remain. It is generally not necessary to remove old wood shingles, old asphalt shingles, or old roll roofing before applying a new asphalt roof, provided a competent inspection indicates that:

(1) The strength of the existing deck and framing is adequate to support the weight of workers and additional new roofing, as well as the usual snow and wind loads.
(2) The existing deck is sound and will provide good anchorage for the nails used in applying the new roofing.

(A) Old Roofing to Remain in Place

(1) If such inspection indicates that old wood shingles may remain, the surface of the roof should be carefully prepared to receive the new roofing by:

(a) Removing all loose or protruding nails, and renailing in a new location.
(b) Nailing down all loose shingles.
(c) Splitting all badly curled or warped old shingles and nailing down the segments.
(d) Replacing missing shingles with new ones.
(e) When the work is being done in a location subject to the impact of unusually high winds, the shingles at eaves and rakes should be cut back far enough to allow the application at these points of 4" to 6" nominal 1" thick wood strips. Nail the strips firmly in place, allowing their outside edges to project beyond the edges of the deck the same distance as did the wood shingles.
(f) To provide a smooth deck to receive asphalt roofing it is further recommended that a "backer board" be applied over the wood shingles or that bevelled wood "feathering strips" be used along the butts of each course of old shingles.

(2) If old Asphalt Shingles are to remain in place, nail down or cut away all loose, curled or lifted shingles; remove all loose and protruding nails; remove all badly worn edging strips and replace with new; and just before applying the new roofing, sweep the surface clear of all loose debris.
(3) When new Asphalt Roofing is to be laid over Old Roll Roofings without removing the latter, proceed as follows to prepare the deck:

Courtesy of War Department

Fig. 10 - Treatment of old roll roofing to remove wrinkles before reroofing.

(a) Slit all buckles and nail segments down smoothly. See Fig. 10.

(b) Remove all loose and protruding nails.

(c) If some of the old roofing has been torn away leaving sections of the deck exposed, examine such areas to note any loose or pitchy knots and excessively resinous areas. Such defects should be covered with sheet metal patches made from galvanized iron, painted tin, zinc, or copper, having a thickness approximately equal to 26 gauge.

(B) Old Roofing To Be Removed

When the framing supporting the existing deck is not strong enough to support the additional weight of roofing and workers during application, or when the decking material is so far gone that it will not furnish adequate anchorage for the new roofing nails, the old roofing, regardless of type, must be removed before applying the new roofing. The deck should then be prepared for the new roofing as follows:

1 - Make repairs to the existing roof framing where required to level and true it up and to provide adequate strength.

2 - Remove all rotted or warped old sheathing (delaminated units in the case of plywood) and replace with new sheathing of like kind.

3 - Fill in all spaces between boards with securely nailed wood strips of the same thickness as the old deck; or move existing sheathing together and sheath remainder of the deck.

4 - Pull out all protruding nails and renail sheathing firmly at new nail locations.

5 - Cover all large cracks, slivers, knot holes, loose knots, pitchy knots and excessively resinous areas with sheet metal securely nailed to the sheating.

6 - Just before applying the new roofing, sweep the deck thoroughly clean of all loose debris.

3. FLASHINGS

Because roofs are more often than not complicated by the intersection of other roofs, adjoining walls, or projections through the deck, such as chimneys and soil stacks, all of which create opportunities for leakage, special provision must be made for turning the weather at these points. Such construction is commonly called "flashing". Careful attention to flashing is very essential to good roof performance, regardless of the type of construction or the cost thereof. Typical methods of flashing are illustrated on Pages 24 to 35.

(a) Open Valley

Valleys exist where two sloping roofs join at an angle causing run-off toward the joint. Because drainage concentrates at the joint, it is especially vulnerable. A smooth unobstructed drainage way must be provided with enough capacity to carry away the water rapidly.

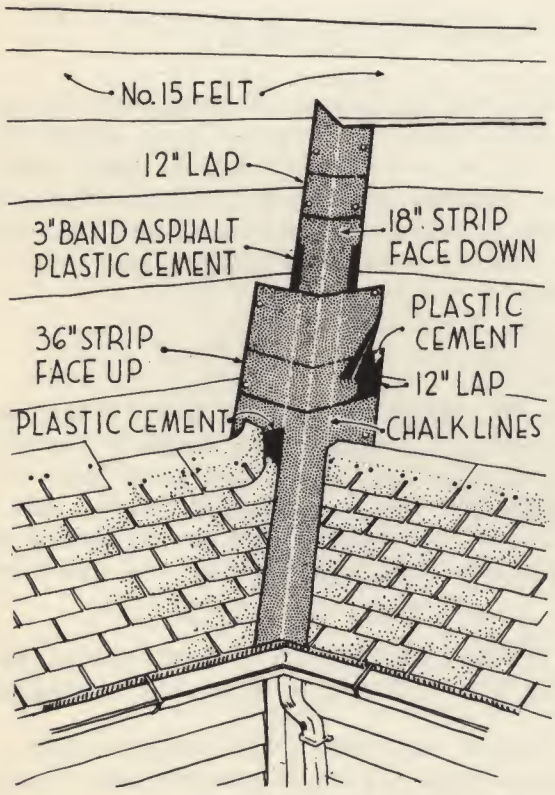


Fig. 11 - Use of roll roofing for typical valley flashings

Mineral surfaced asphalt roll roofing of a color to match or to contrast with the roof covering is satisfactory for flashing valleys. The method is illustrated in Fig. 11.

The flashing is applied after the felt is laid down but before the roofing is applied.

An 18" wide layer of mineral surfaced roll roofing is centered in the valley, surfaced side down, the lower edge cut to conform to and flush with the eaves drip edge. When necessary to splice the material, the ends are lapped at the joint and secured with asphalt plastic cement applied as shown. Only enough nails are applied in rows one inch in from each edge to hold the strip smoothly in place.

As the nailing along the second side proceeds, the roofing is pressed firmly into the valley. A 3" wide band of asphalt plastic cement is applied along each edge of the 18" strip after it is nailed, covering all nail heads.

On top of the first strip another strip 36" wide is placed, surfaced side up, centered in the valley, and secured with nails in the same manner as the underlying 18" strip.

Before the roofing is applied, two chalk lines are snapped the full length along the valley, one on each side, so that they will be 6" apart at the ridge, (3" measured from the center of the valley along each of the intersecting roofs), and will diverge at the rate of 1/8" per foot as they approach the eaves. A valley 8 feet long will be 7 inches wide at the eaves, and one 16 feet long will be 8 inches wide at the eaves. When a course of shingles or roll roofing is brought to the valley, the chalk line serves as a guide in trimming the last unit to fit, thus insuring a clean sharp edge. The upper corner of each end shingle is clipped as shown in Fig. 11 to prevent water from penetrating between the courses. The roofing material is cemented to the valley lining with asphalt plastic cement.

(b) Closed or Woven Valley

The valley treatment illustrated in Fig. 12 is preferred by some applicators, but its use is limited to strip type shingles. Individual shingles cannot be used because nails might then be required at or near the center of the valley lining. The method has the advantage of doubling the shingles throughout the length of the valley, thereby adding to the weather resistance of the roof at a point which might otherwise be most vulnerable.

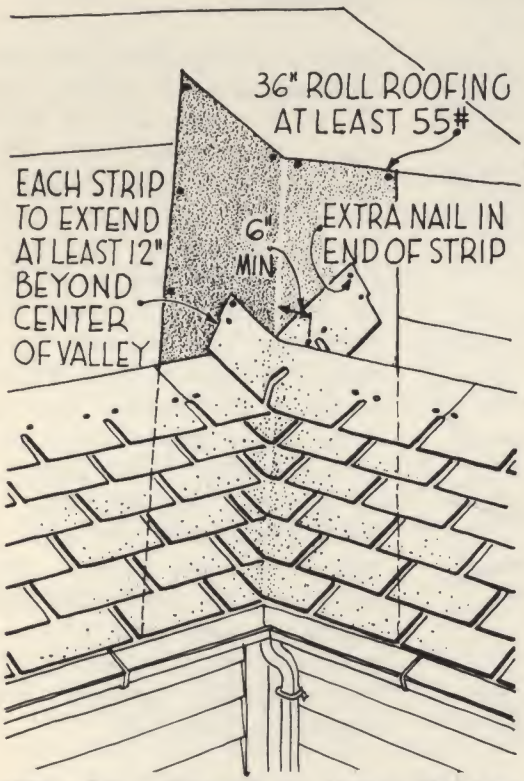


Fig. 12 - Closed or Woven Valley

The first step in constructing the valley is to lay a 36" width of 55# smooth roll roofing centered in the valley over the No. 15 asphalt saturated felt underlayment.

Valley shingles are laid over the lining either, 1) by applying them on both roofs at the same time, weaving each course in turn over the valley, or 2) by covering each roof first to a point approximately three feet from the center of the valley and weaving the valley shingles in place later.

When following the first procedure the first course is laid along the eaves of one roof up to and over the valley, extending it along the adjoining roof deck for a distance of at least 12". The first course is then laid along the eaves of the adjoining roof and is carried over the valley on top of the previously applied shingle. Succeeding courses are then laid alternately, first along one roof deck and then along the other, weaving the valley shingles over each other as shown in Fig. 12.

When following the second procedure, the valley shingles are woven in the same manner.

Make sure that the shingles are pressed tightly into the valley and then apply nails in the normal manner except that no nail is applied closer than 6" to the valley center line, and that two nails are applied as shown at the end of each terminal strip. In order to avoid placing a nail too close to the center of the valley it may be necessary occasionally to cut a strip short that would otherwise end near the center, and to continue from this cut end over the valley with a full length strip.

When reroofing it is recommended that the old valley be built up with a wood strip to the average level of the old roofing.

(c) Flashing Against A Vertical Wall --- New Construction

When the rake of a roof abuts a vertical wall, as in Fig. 13, the most satisfactory method of protecting the joint is to use metal "flashing shingles" applied over the end of each course of shingles. The method is called "step flashing".

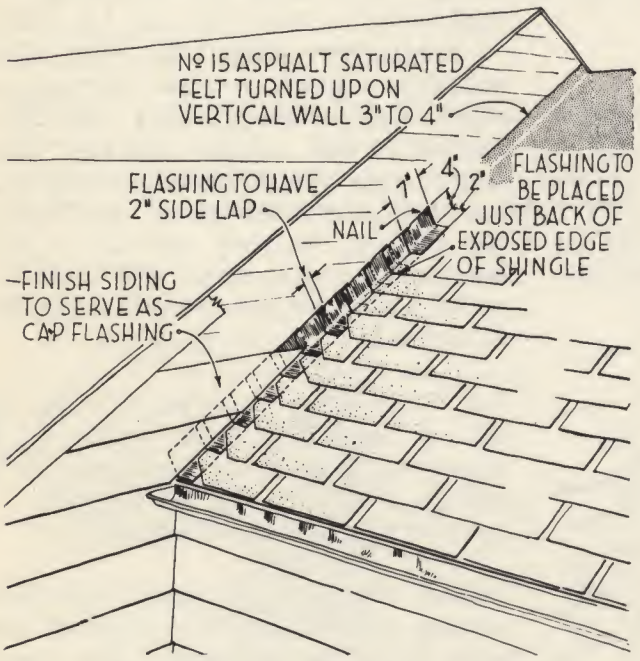


Fig. 13 - Use of metal flashing shingles to protect joint between sloping roof and vertical wall.

The flashing shingles are rectangular in shape, from 5" to 6" long and 2" wider than the exposed face of the roofing shingles. When used with strip shingles laid 5" to the weather, they are 6"x7". They are bent so as to extend 2" out over the roof deck and the balance up the wall surface. Each flashing shingle is placed just up-roof from the exposed edge of the shingle which overlaps it and is secured to the wall sheathing with one nail in the top corner as shown. As the metal is 7" wide, and the roof shingles are laid 5" to the weather, each element of flashing will lap the next by 2", as shown in Fig. 13.

The finish siding is brought down over the flashing to serve as cap flashing, but is held far enough away from the shingles so that the ends of the boards may be readily painted to exclude dampness and prevent rot.

(d) Flashing Against A Vertical Wall --- Reroofing

Fig. 14 shows how the joint between a vertical wall and the rake of an abutting roof is treated when new asphalt shingles are being applied over an old roof. After leveling down the old shingles, as described on Page 22, a strip of smooth roll roofing 6" or 8" wide is applied

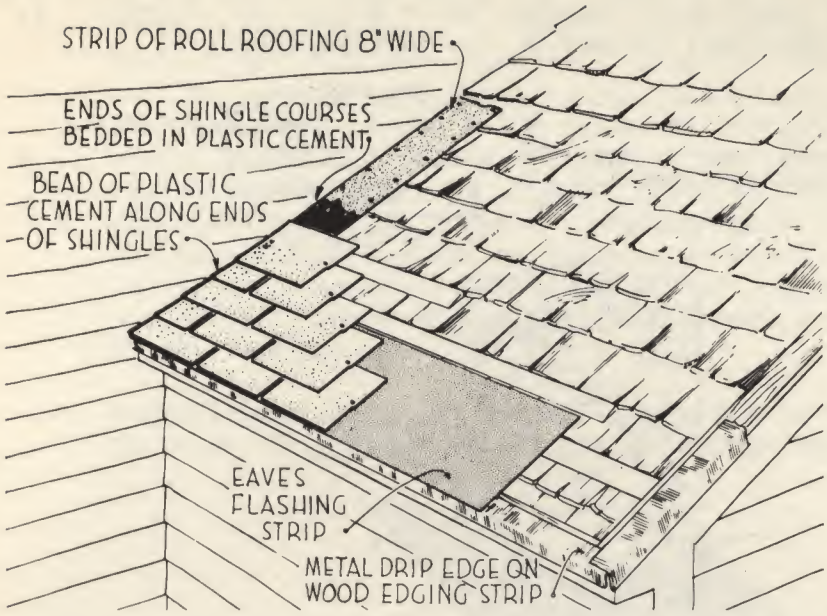


Fig. 14 - Flashing against a vertical wall when reroofing over old material.

over the shingles close up against the wall surface, using a row of nails along each edge, the nails to be approximately 4" on centers. As the work proceeds, this strip is covered with asphalt plastic cement. The end of each course of new shingles is firmly secured by bedding it in the cement.

An improved appearance and a tight joint can be achieved by using a caulking gun to apply a bead of plastic cement between the ends of the shingles and the siding boards.

(e) Chimneys

To avoid stresses and distortions due to uneven settling, the chimney is frequently built on a separate foundation from that which supports the structure, and is normally subject to some differential settling. Therefore, flashing at the point where the chimney projects through the roof calls for construction which will allow for such movement without damage to the water seal. It is necessary to use base flashings which are secured to the roof deck, and counter or cap flashings which are secured to the masonry. Figures 15, 16, 17 and 18 show how roll roofing is used for base flashing and metal for cap flashing.

Before any flashings are placed, shingles are applied over the roofing felt up to the front face of the chimney, and a cricket or saddle is constructed as shown in Fig. 16 between the back face of the chimney and the roof deck. The purpose of

the cricket is to prevent the accumulation of snow and ice and to deflect downflowing drainage water around the chimney. It is a very important element of the construction.

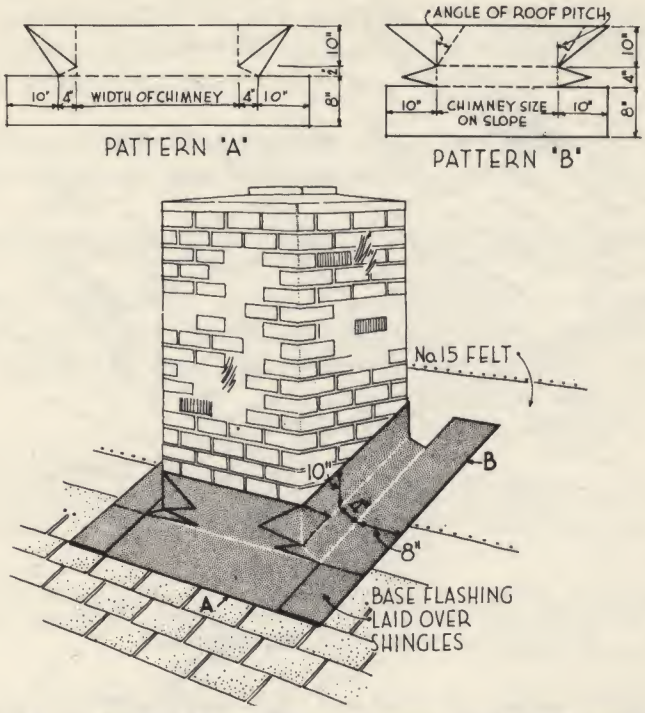


Fig. 15 - Base flashing patterns cut and applied.

In addition, a coat of asphalt primer is applied to the brick work to seal the surface at all points where plastic cement will later be applied.

The base flashing for the front, cut according to the pattern "A" shown in Fig. 15 (upper left), is first applied. The lower section is laid over the shingles in a bed of asphalt plastic cement, and the upper vertical section is secured against the masonry with asphalt plastic cement and with nails driven into the mortar joints. The triangular ends of the upper section are bent around the corners of the chimney and cemented in place.

The side base flashings, pattern "B", Fig. 15 (upper right) are next cut, bent to shape, and applied as shown, bedded in asphalt plastic cement. They are secured to the deck with plastic cement and to the brick work with plastic cement and nails. The triangular ends of the upper section are turned around the chimney corners and cemented in place over the front base flashing.

Fig. 16 illustrates a method of cutting and fitting base flashings over the cricket. The cricket consists of two triangular pieces of board cut to form a ridge which extends from the center line of the chimney back to the roof deck. The boards are nailed to the wood deck and to each other along the ridge before the felt

underlayment is applied. The base flashing, (pattern "C", Fig. 16) is cut and bent to cover the entire cricket, and extends at least 6" up the brickwork. The deck portion extends laterally to cover part of the side base flashing. A second rectangular piece of roofing, (pattern "D" with a V cut out on one side to conform to the rear angle of the cricket) is set tightly in asphalt plastic cement centered over that portion of the cricket flashing which extends up the deck. This piece provides added protection at the point where the ridge of the cricket joins the deck. A second similar rectangular piece of flashing with a V cut from one side to conform to the pitch of the cricket is placed over the cricket ridge and against the chimney, bedded in asphalt plastic cement.

Asphalt plastic cement is used generously to cement all standing portions of the base flashing to the brick work.

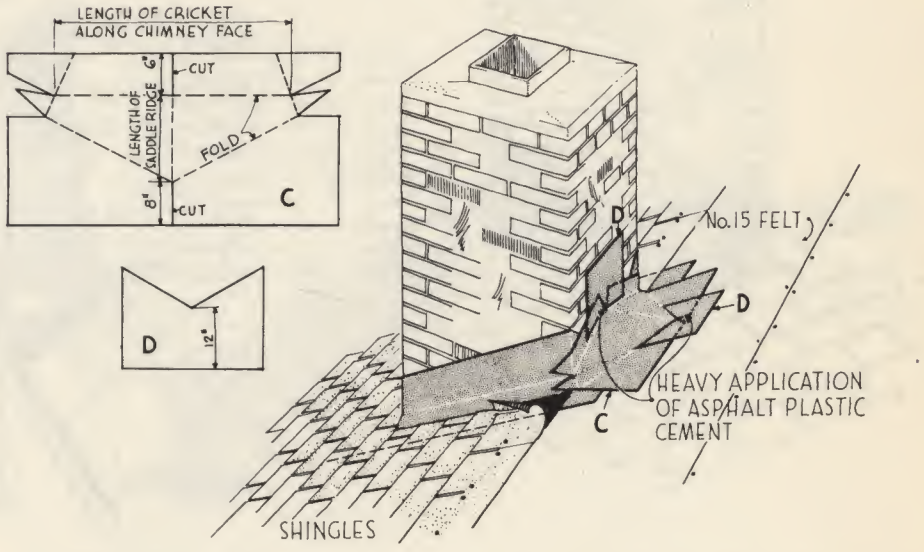


Fig. 16 - Flashing over cricket in rear of chimney.

Cap flashings shown in Fig. 17 are recommended to be of sheet copper, 16 oz. or heavier, or 24 gauge galvanized steel. If the latter is used it should be painted on both sides.

Fig. 18 shows a good method of securing cap flashing to brick work. The mortar joint is raked out to a depth of one and one-half inches, and the bent back edge of the flashing is inserted in the cleared space between the bricks as shown. Once in under slight spring tension it cannot easily be dislodged. The joint is then refilled with Portland Cement mortar or asphalt plastic cement, and the flashing bent down to cover the base flashing and to lie snugly against the masonry.

The front unit of the cap flashing is one continuous piece. On the sides and rear the sections are of similar size cut to conform to the locations of brick joints and pitch of roof. The side units lap each other as shown in Fig. 17 at least 3".

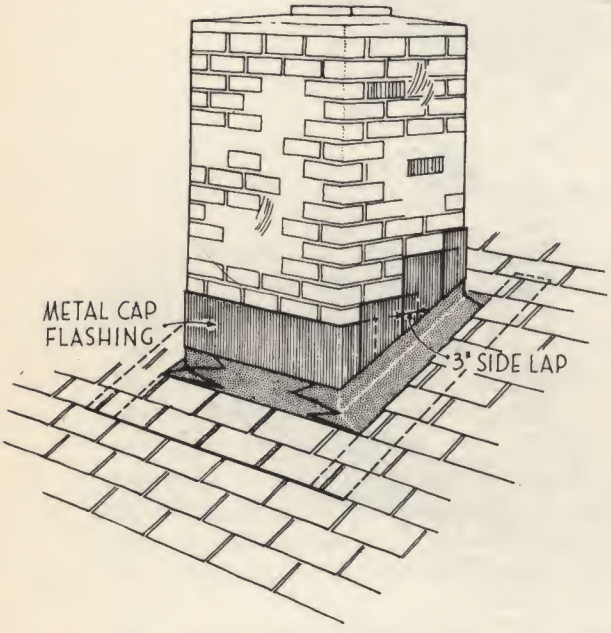


Fig. 17 - Metal cap flashing applied to cover base flashing.

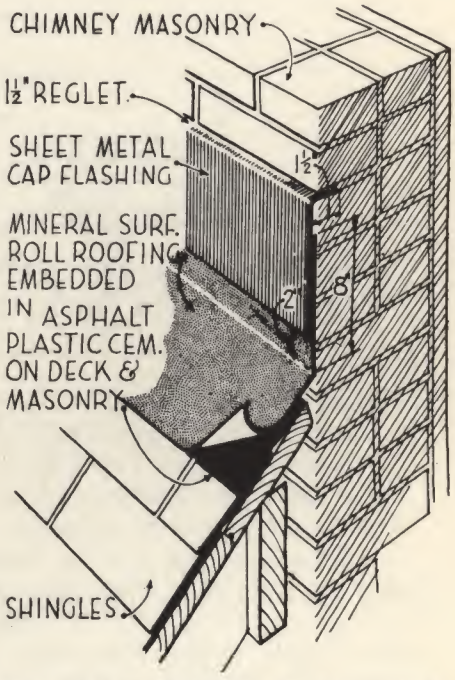


Fig. 18 - Method of securing cap flashing to the masonry.

An alternate method of flashing a sloping roof which abutts a vertical masonry wall is shown in Fig. 19. This is known as "step flashing". It consists of placing a rectangular piece of flashing material 8" x 22" over the end of each course of shingles, holding the lower edge slightly back of the exposed edge of the covering shingle, and bending it up against the masonry, to which it is secured with asphalt plastic cement. The nails are driven through the lower edge of the flashing into the roof deck. These nails are covered with the plastic cement which is used to secure the end shingle to the horizontal portion of the flashing, and also by the shingle itself. The operation is repeated for each course. The flashing units are wide enough to lap each other at least 3", the upper one overlaying the lower one each time as shown.

When asphalt roofing is used in this way for step flashing, it simply replaces the base flashing previously described. Metal cap flashing must also be applied in the usual manner to complete a satisfactory job.

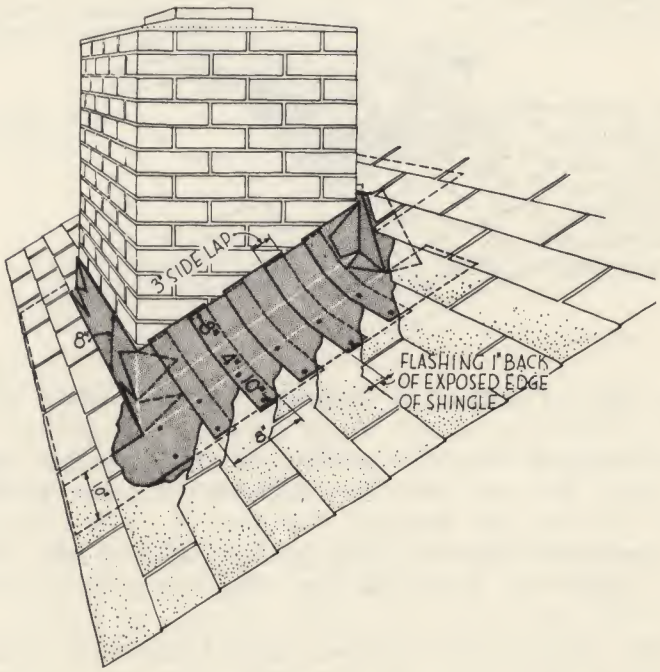


Fig. 19 - Alternate method of applying base flashing, known as "step flashing".

(f) Chimney Flashing When Reroofing

A chimney projecting through a sloping wood shingle roof which is being resurfaced with asphalt shingles is shown in Fig. 20. Because asphalt plastic cement is to be used, and must adhere firmly to the masonry, it is necessary first to apply a priming coat of cut-back asphalt coating to seal the surface of the brick work.

The next step is to apply 4 strips of roll roofing, approximately 8" wide, on the wood shingles, each laid tightly against one side of the chimney, securing them with a row of roofing nails along each edge. As the work proceeds these strips are coated with asphalt plastic cement, in which the new shingles are firmly embedded.

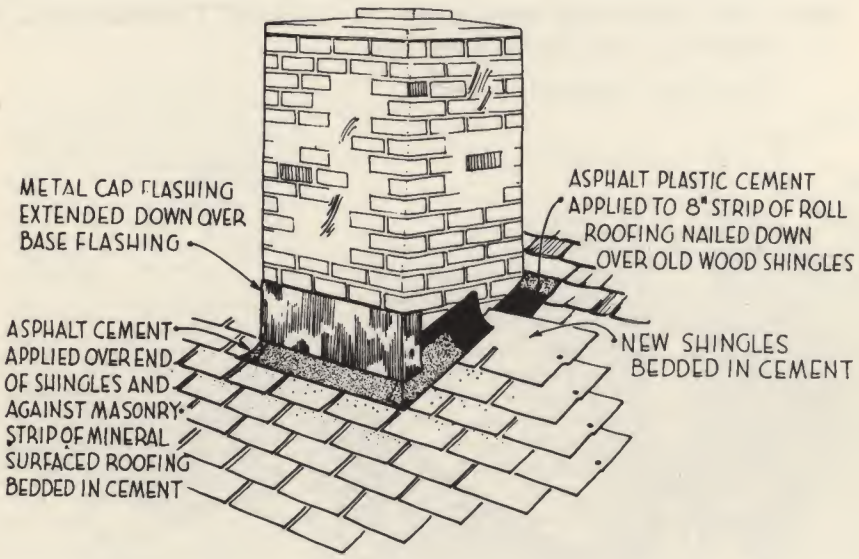


Fig. 20 - Flashing a chimney over old wood shingles.

After applying an asphalt primer to the masonry, plastic cement is applied over the new shingles adjacent to the chimney for a short distance, and up the masonry for from 4 to 6 inches. A strip of mineral surfaced roll roofing of suitable width is then pressed into the cement as shown in Fig. 20, the side pieces being returned around and over the front piece. The strip along the back (not shown) should be returned around and over the side pieces. If the old construction did not provide a cricket or saddle behind the chimney, the strip along the back should be wide enough to extend up the roof deck and be lapped at least 6" by the first course of new shingles above the chimney.

Metal cap flashing is brought down over the top edge of the strips as close to the new roofing as possible.

(g) Soil Stacks

Practically every dwelling, and most industrial and farm buildings have pipes or ventilators projecting through the roof which are circular in section and call for special flashing methods. Non-corrodible metals such as copper and lead are frequently used, and prefabricated units with adjustable flanges are usually obtainable to fit any roof slope.

Asphalt Roofing Products may be used successfully. A common and acceptable flashing design for soil stacks is illustrated here and may be considered typical.

Figs. 21, 22, 23, 24, 25 and 26 show step by step how the flashing is cut and applied.

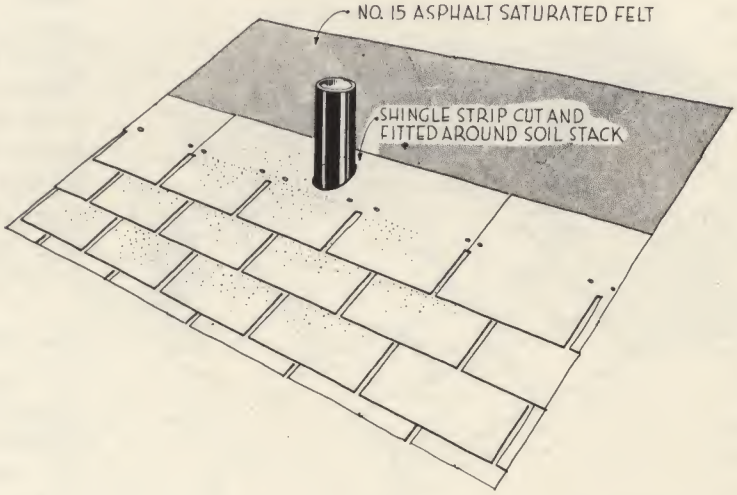


Fig. 21 - Roofing is first applied up to the pipe and fitted around it.

Procedure

1. The roofing is applied up to the point where the pipe projects, and the nearest element is cut and fitted around the pipe as shown in Fig. 21.

2. Before the roofing is applied beyond the pipe, a flashing flange is prepared and installed as follows:

   (a) A rectangular flange is cut from either 55 lb. smooth or 90 lb. Mineral Surfaced Roll Roofing which is large enough to extend 4" below the pipe, 8" above the pipe, and 6" on each side of the pipe when installed. It should preferably

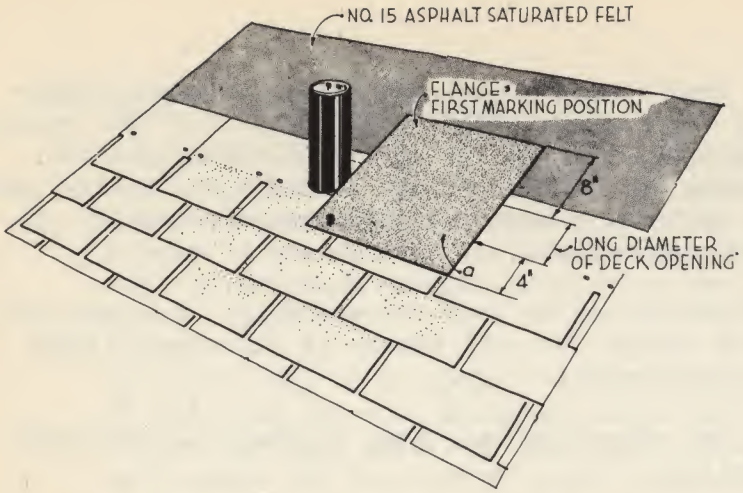


Fig. 22 - First step in marking opening.

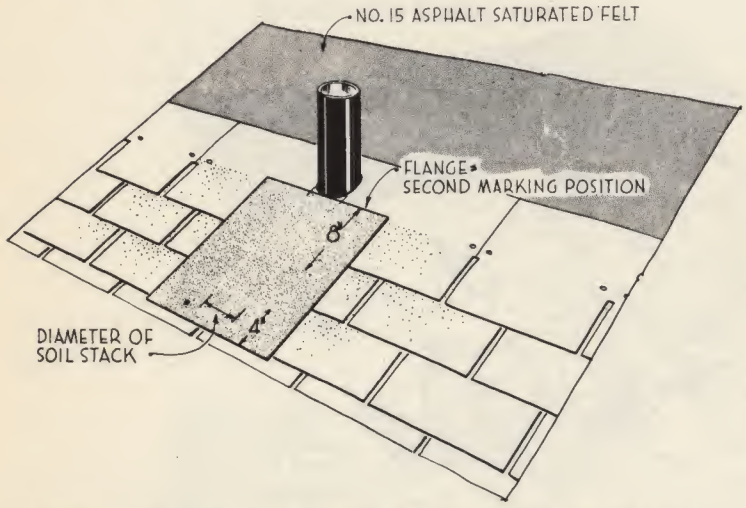


Fig. 23 - Second step in marking opening.

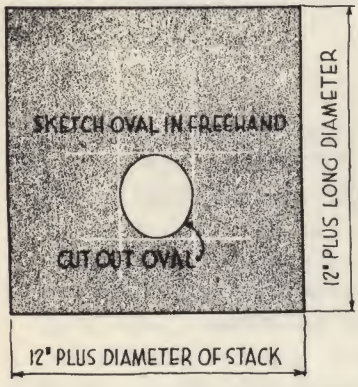


Fig. 24 - Cut oval in flange.

be in one piece, but if this is not possible, the total length of the material should provide for at least 2" of lap where horizontal joints may occur.

(b) Figs. 22 and 23 show how the opening through which the pipe will project is located on the flange. First, a line, shown at "a", Fig. 22, is marked 4" above and parallel to the lower edge, and the material is laid on the roof adjacent to the pipe so that this line will be even with the down-roof side of the pipe. Another mark is then drawn parallel to the first and even with the up-roof side of the pipe.

Second, the flange is laid on the roof below the pipe and its center aligned with the center of the pipe as shown in Fig. 23. Two more parallel lines are drawn, at right angles to the first pair, even with the sides of the pipe. The resulting oblong marks the exact location of the opening. The oval can then be sketched freehand with sufficient accuracy for the purpose and cut out as shown in Fig. 24.

(c) The flange is then slipped over the pipe and laid flat on the roof. A collar is formed around the pipe with plastic cement extending it up the pipe about 2" and out over the flange a like amount as shown in Fig. 25. The cement must be vigorously and thoroughly trowelled in place so that

it will adhere properly and so that all air pockets in the cement will be eliminated.

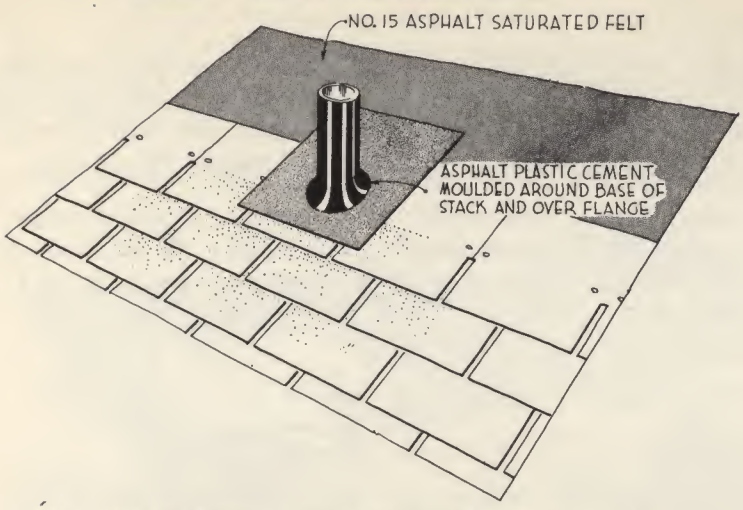


Fig. 25 - Cement collar applied around pipe and over flange.

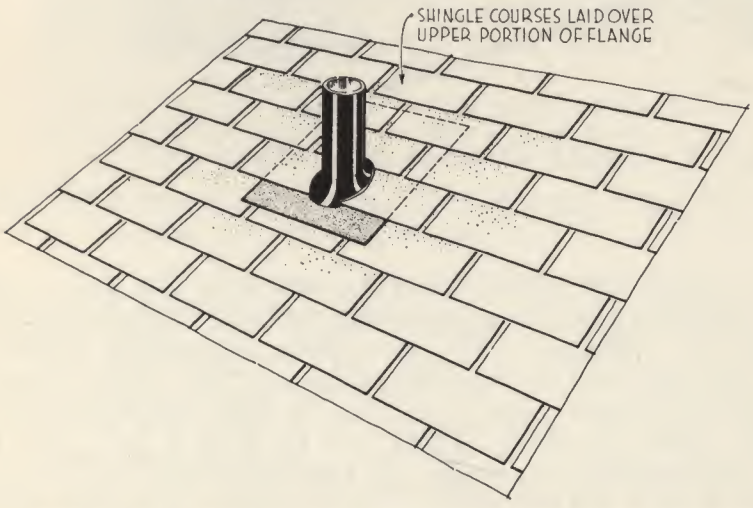


Fig. 26 - Shingling completed past and above the pipe.

3. After the flashing is applied, the shingling is continued up the roof as shown in Fig. 26. The lower part of the flange laps over the shingles, while along the sides and at the back of the pipe, the shingles cover the flange. The shingles are fitted around the pipe and bedded in plastic cement where they overhang the flange. It is important to avoid driving any nails close to the pipe.

4. Ventilators, Exhaust Stacks, Etc. located at the ridge are flashed in essentially the same manner except that the flange is bent over both sides of the ridge and laps the roof shingles at all points. Hip shingles are installed to cover the flashing and are bedded in plastic cement where they meet the pipe.

5. Re-Roofing - Old metal flashing around the pipe should be examined carefully. If it is deteriorated, remove it and apply new flashing as explained above. If the metal flashing is in good condition, proceed as follows:

   (a) Lift the lower part of the flange and apply the shingles underneath it up to the pipe.
   (b) Replace the flange, bedding it in plastic cement.
   (c) Protect the junction of the metal sleeve and the flange with an application of plastic cement.
   (d) Proceed to apply shingles around the pipe and up the roof.

APPLICATION OF STRIP SHINGLES

1. GENERAL

Before starting to apply strip shingles it is necessary that the deck be properly prepared; in the case of new construction, that an underlayment be first applied; and in the case of reroofing, that the old surface be treated according to the instructions included on Pages 22 to 25.

Figs. 29, 30 and 31 show three-tab square butt strips applied over an underlayment of No. 15 Asphalt Saturated Felt, and Figs. 32 and 33 show a similar application of two and three-tab hexagonal strips. In all cases the procedure is as follows:

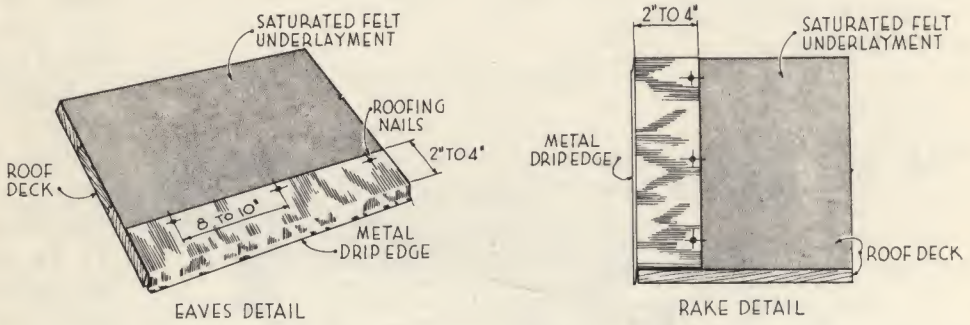


Fig. 27 - Detail of metal drip edge.

2. APPLICATION

(a) Metal Drip Edge - Along the eaves and rake and over the felt, lay a strip of corrosion-resistant 26 gauge sheet metal. Galvanized steel, painted both sides is commonly used, but other equivalent metals are acceptable. Secure the strips with suitable roofing nails, spaced 8" to 10" apart along its inner edge. It may be bent downward even with the rake and eave lines as shown in Fig. 28 to form a drip, or it may be a flat piece overhanging the edges of the deck from 1/4" to 3/8". In either case it should extend from 2" to 4" back along the deck.

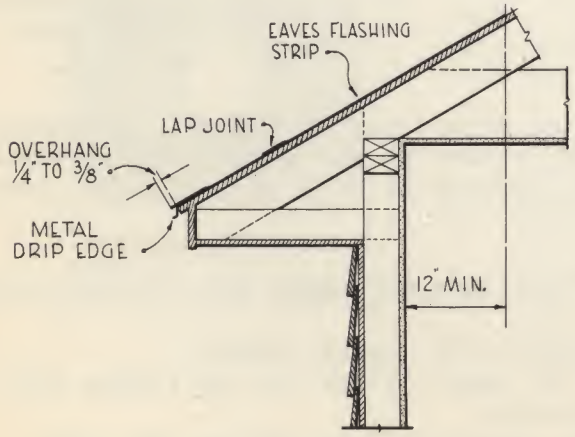


Fig. 28 - Coverage of eaves flashing strip.

(b) Eaves Flashing Strip - Overhanging the lower edge of the drip edge from 1/4" to 3/8", an "eaves flashing strip" of 90 lb. mineral surfaced or 55 lb. smooth roll roofing is applied. It extends up the roof far enough to cover a point at least 12" inside the inside wall line of the building. When the overhang of the eaves requires the strip to be wider than 36", the horizontal lap should be made on the lower portion of the roof deck beyond the outside wall line of the building. See Fig. 28. The strip is intended to prevent damage to the roof deck and interior wall and ceiling finish, should the roof drainage system clog up due to formation of ice in eaves troughs and consequent backing up of snow and slush.

(c) Starter Course - Over the eaves flashing strip, and flush with its lower edge, a starter course of shingles is laid with tabs facing up the roof. A part of the first strip (approximately 3") is cut off to insure that all cutouts will be covered by the first regular course of shingles. The first unit should be set flush with the rake end of the eaves flashing strip.

In the case of hex strips, the first shingle should not be cut.

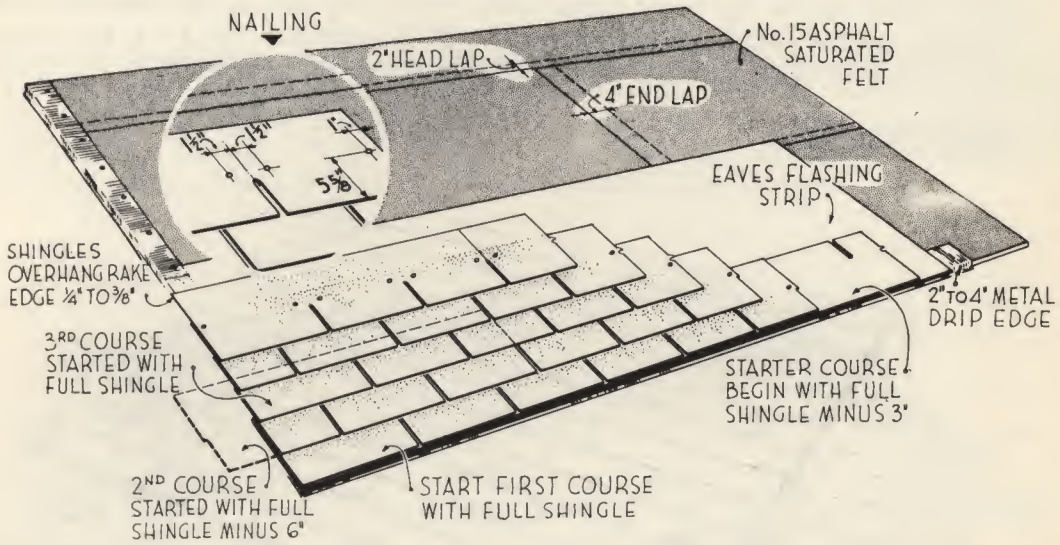


Fig. 29 - Three-tab square butt strips. Cutouts are centered over the tabs in the course below.

(d) First and Succeeding Courses - The first course is started with a full length strip. The second course is started with a strip from which a portion has been cut off, while succeeding courses start with full or cut shingles, depending upon the style of shingles being used and the method of application followed. Fig. 29 shows the second course starting with a strip from which one half of the end tab has been cut off, resulting in cutouts being centered over the tabs of the course below.

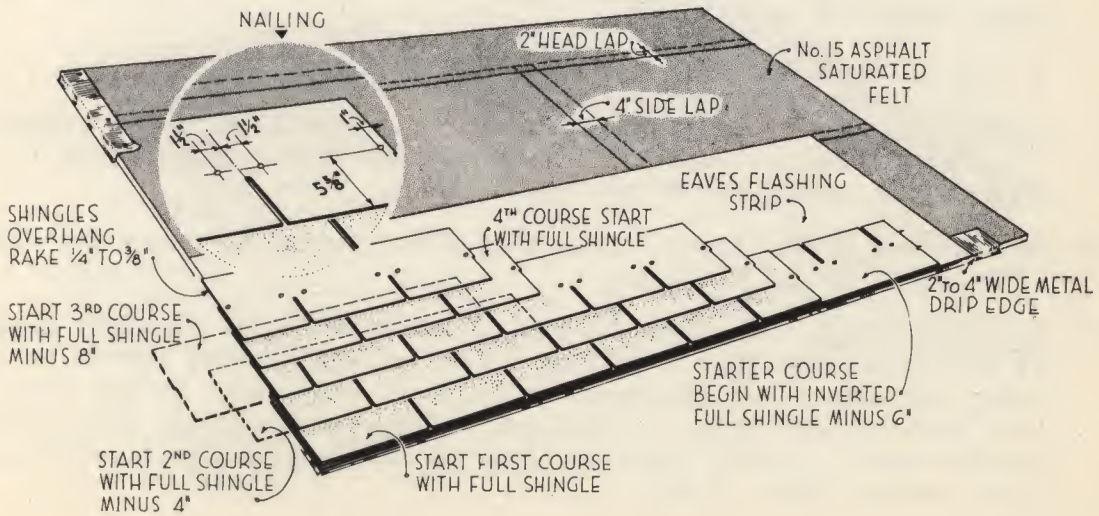


Fig. 30 - Three-tab square butt strips. Cutouts break joints in thirds.

Fig. 30 (page 37) shows the second course starting with a strip from which 4" has been cut off the end tab, and the third course with one from which 8" has been cut off, causing the cutouts to break joints in thirds with the tabs in the course below. The fourth course is even with the first.

Some authorities recommend, and some applicators prefer, to start each succeeding course after the first, up to and including the sixth, with a strip from which an additional half of a tab has been removed, the seventh course being started with a full strip. This is to conserve the applicator's time if very much scaffolding is needed for the job.

(e) Random Spacing

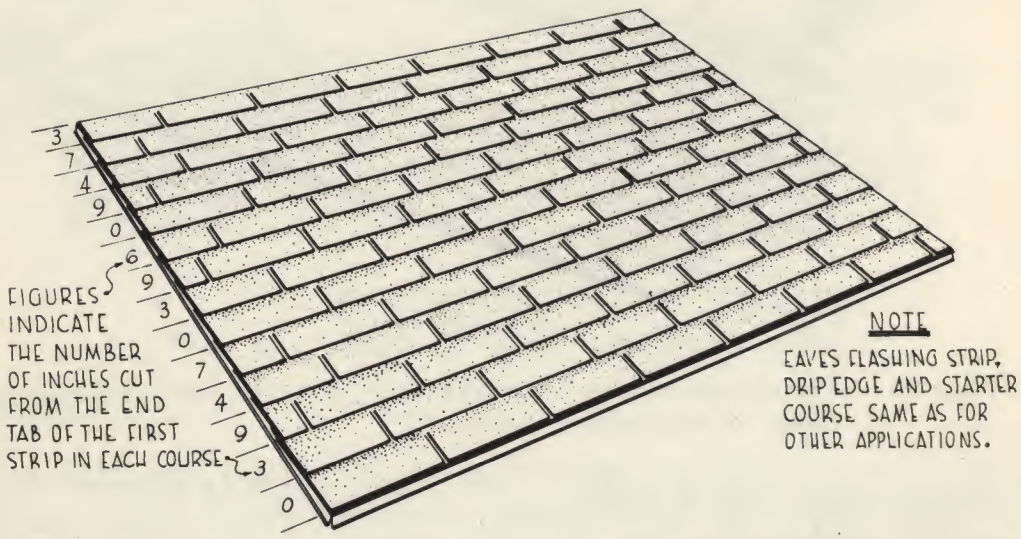


Fig. 31 - Random spacing of three-tab square butt strips.

Fig. 31 shows a method of spacing cutouts at irregular intervals called "random" spacing. The arrangement shown is only one of many possibilities, but whatever system is used it should conform to the following three important principles:

1- The width of any rake tab should be at least 3".

2- Arrangement should provide for cutout centerlines in any course being located at least 3" laterally from cutout centerlines in both the course above the course below.

3- Rake tab widths should not repeat close enough to cause the eye to follow a cutout alignment.

(f) Wind Protection - In order to protect strip shingles in windy locations, it is recommended that a spot of quick setting asphalt cement be applied under the center of the exposed portion of each tab. Do not bend the tabs back farther than is necessary to place the cement, and exercise special care in those areas of the roof most vulnerable to wind; namely, along eaves, rakes, ridge.

(g) Nailing - Nailing is extremely important. Weather resistant roofing nails having a large head, at least 3/8" diameter, and a shank long enough to penetrate to the under surface of the roof deck should be used. The number of nails required varies with the product. Three-tab square butt strips should have six nails located as shown in Figs. 29 and 30; in the case of thick butt strips they should be driven through the thick portion of the strip. The two and three-tab hex strips require four nails each, located as shown in Figs. 32 and 33.

To avoid buckling, see that the shingle is in perfect alignment before driving any nails. Start nailing at the end nearest the shingle last applied and proceed to the opposite end. Drive nails straight to avoid cutting the fabric of the shingle with the edge of the nail head. Do not sink the nail head into the surface of the shingle.

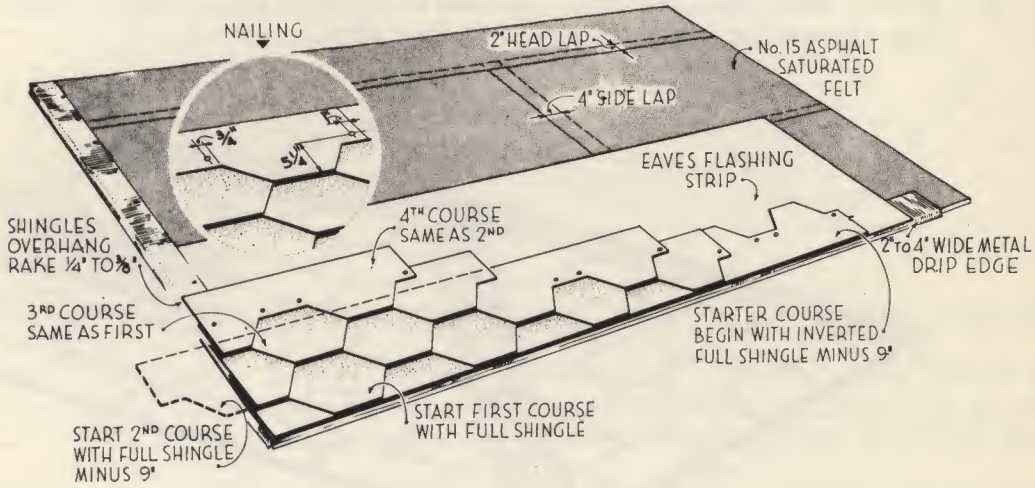


Fig. 32 - Application of two-tab hex strips.

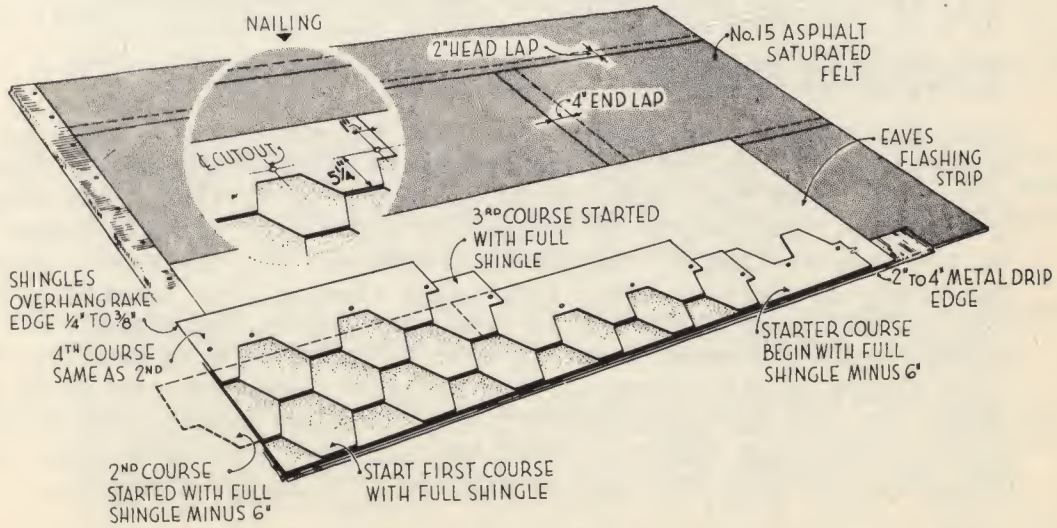


Fig. 33 - Application of three-tab hex strips.

(h) Hips and Ridges - Individual shingles for finishing hips and ridges are available from most manufacturers, but can also be cut from the shingles that are used to cover the roof. Never use metal ridge roll with asphalt roofing products as corrosion may discolor the roof. Fig. 34 shows hip and ridge shingles applied on three-tab square butt strips.

The following method of applying hip and ridge shingles is the same regardless of the type of shingle used on the roof.

1 - Bend each shingle lengthwise down the center so as to have equal exposure on each side of the hip or ridge. In cold weather warm the shingle before bending.

2 - Beginning at the bottom of a hip or at one end of a ridge, apply the shingles over the hip or ridge exposing them 5".

3 - Secure each shingle with one nail on each side, 5-1/2" back from the exposed end and 1" up from the edge.

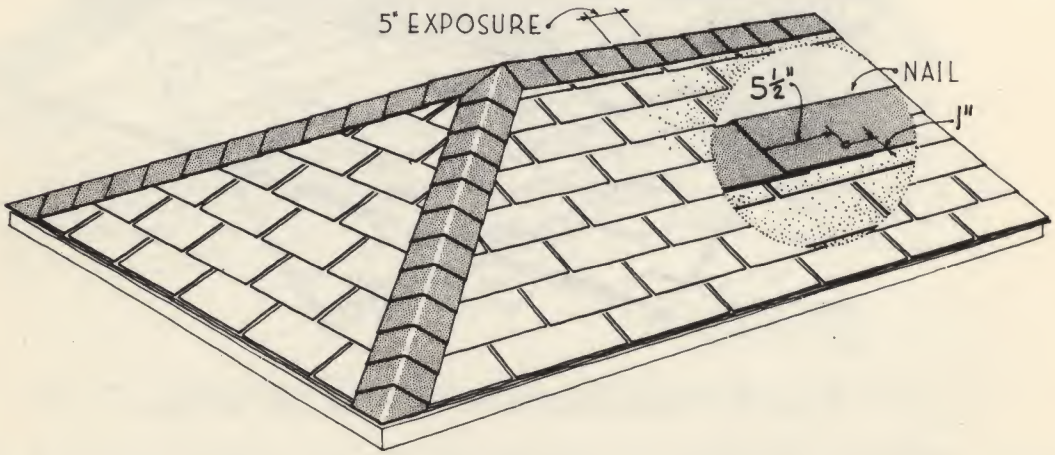


Fig. 34 - Hip and ridge shingles applied with three-tab square butt strips.

(i) Alternate for Low Slopes

When the rise is less than 4" per foot but more than 2-1/2", an additional underlayment of No. 15 asphalt saturated felt is applied by lapping each course 19" over the course below and securing it with nails staggered on 9" centers. Each strip is secured in place with asphalt cement applied on the back so that it completely covers all but the tabs. After placing the strip in position apply four nails along a line located about 1" below the top edge, one about 1-1/2" from each end of the strip, and the others equally spaced between them. A spot of quick setting asphalt cement is then placed on the surface of the shingles under the center of each overlying tab, and the tab pressed firmly into the cement. It is important to place only enough cement to hold the shingle in place without an excess squeezing out over the exposed surface of adjacent shingles.

APPLICATION OF LOCKED DOWN INDIVIDUAL SHINGLES

1. GENERAL

Individual hex shingles are of two types; those that are fastened down with a staple in the lower corner, as shown in Fig. 35-A and those that are secured by means of tabs which project from the lower corner in such a manner that they can be inserted under the adjacent edges of the shingles in the course next below, as shown in Fig. 35-B.

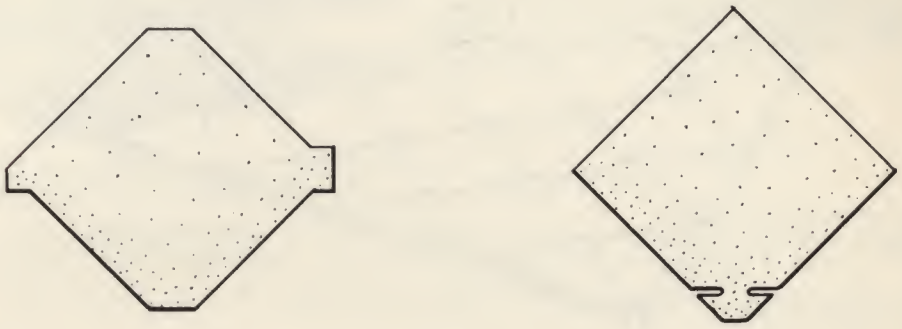


Fig. 35-A - Typical staple down shingle 35-B - Typical lock down shingle

(a) Roof Deck - Before laying any shingles the roof deck should be prepared in accordance with instructions given on Pages 21 to 24. This is especially important when reroofing over old wood shingles.

(b) Acceptable Methods of Application - These shingles may be laid starting from either end of the roof and working toward the other end as well as by starting in the center and working both ways to the rakes. If it is desired that the rake lines both present the same appearance, then the center starting method must be followed. Both horizontal and vertical chalk lines should be used to insure good alignment in both directions. The illustrations, Figs. 36 and 38, show the shingle courses starting at the left rake.

(c) Eaves Flashing Strip - An eaves flashing strip should be used for individual shingles just as for strip shingles and for the same reasons. It should be wide enough to extend at least 12" inside the inside wall line. See Fig. 28, Page 36.

(d) Metal Drip Edge - A metal drip edge as described and illustrated on Page 36 is recommended for use with individual shingles.

(e) Nails and Nailing - Nails should be as specified for other styles of asphalt roofing. (See Table II, Page 16). When the application is over old asphalt materials, the nails should be 1½" long. When over old wood shingles, they should be 1-3/4" long. They should always be long enough to penetrate at least 3/4" into deck sheathing.

Each staple type shingle is secured with two nails and one fastener. A nail is located 1" up from the lower edge of each shoulder tab and 1" in from the end. A non-corrodible wire fastener is applied

to the lower corner of each shingle in such a manner as to secure it to the adjacent tabs of the shingles in the course next below but not to the shingle in the second course below, which lies on the deck. The tab should never be nailed down.

2. APPLICATION OF STAPLE DOWN SHINGLES

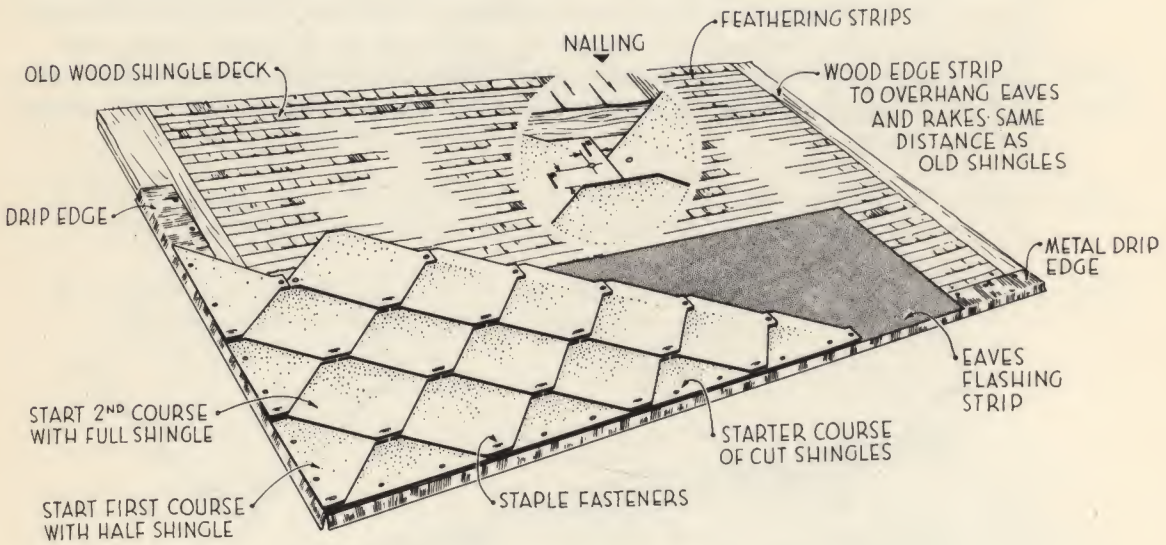


Fig. 36 - Individual hex shingles, staple down type, applied over old wood shingles.

(a) Starter Course

Lay a starter course of shingles from which all that portion below the shoulder tabs has been cut away even with their lower edges. Place the first cut shingle so that its cut edge is flush with the eaves edge of the eaves flashing strip and its left shoulder tab is flush with the rake end of the eaves flashing strip. Continue with cut shingles along the eaves, abutting the shoulder tabs and nailing. When applying the shingles in a windy location embed the lower edges in a band of a quick setting type of asphalt cement not less than 6" wide as shown in Fig. 38. Under normal conditions of exposure place two nails evenly spaced in each starter shingle along the eaves as shown in Fig. 36.

(b) First Course

Start the first course at the left rake edge with a shingle cut in half vertically. Apply the cut edge of the right half of the shingle flush with the overhanging rake edge of the eaves flashing strip, securing it with a staple at the bottom and 3 nails located

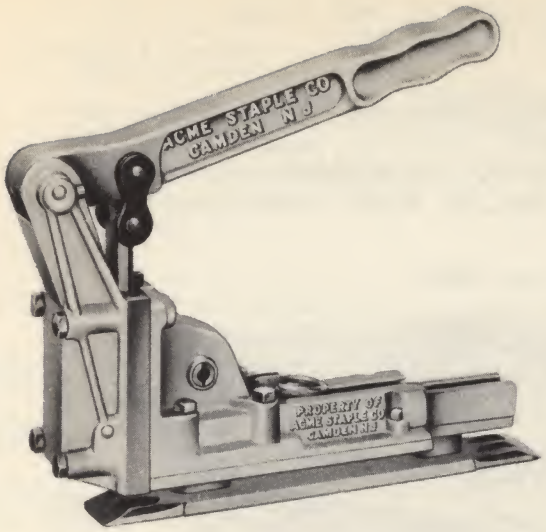


Fig. 37 - Stapling Machine

as shown in Fig. 36. Continue with full size shingles laid with shoulder tabs abutted and aligned, checking the location of each shingle carefully with the vertical chalk lines.

In windy locations apply a 6" strip of 55# roll roofing along the rake extending from the top edge of the eaves flashing strip to the ridge, and set the first shingle of each course in quick setting asphalt cement spread evenly over this "rake starter strip", as shown in Fig. 38.

(c) Second and Succeeding Courses

The second course is started with a full size shingle and continued with full size shingles across the roof, each shingle being secured with two nails and a fastener. The courses are continued up the

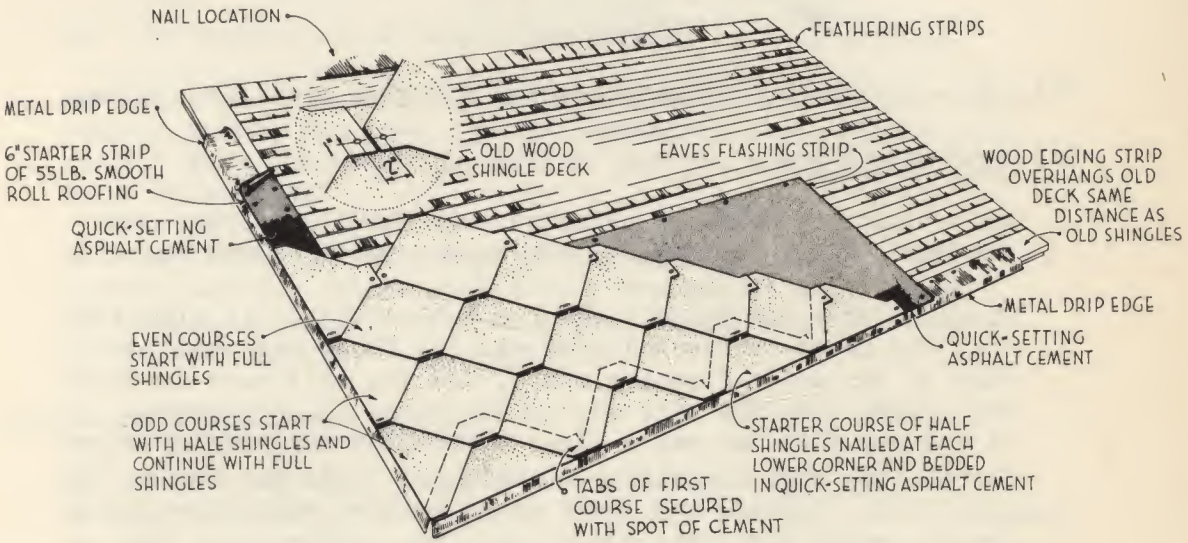


Fig. 38 - Application of individual hex shingle, staple down type, recommended for windy locations.

roof, starting alternately with half and full shingles, all shingles being carefully aligned with the chalk lines. End shingles are trimmed to overhang the rake edges of the deck from 1/4" to 3/8".

In windy locations the first shingle of each course is set in special asphalt cement as shown in Fig. 38.

3. APPLICATION OF INTERLOCKING TYPE INDIVIDUAL SHINGLES

Figs. 39 and 40 illustrate respectively the application details recommended for normal conditions and for windy locations.

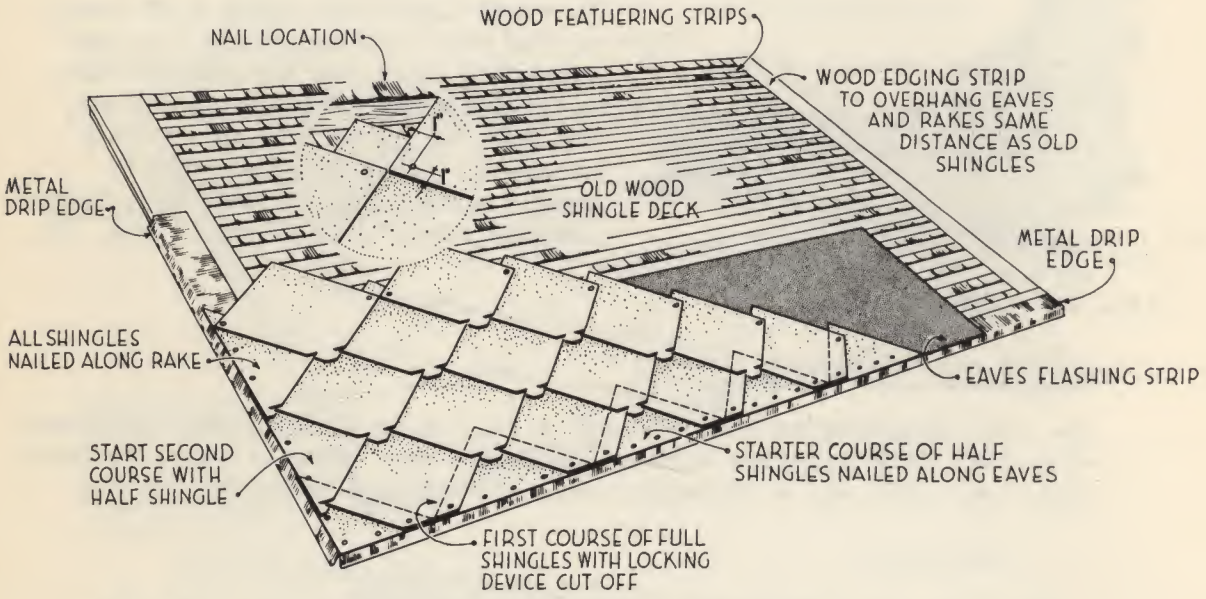


Fig. 39 - Application of interlocking shingles over old roofing.

(a) Starter course

Lay a starter course of shingles from which the lower half has been cut off on a line joining the two shoulder corners.

One-half of a cut shingle ($\frac{1}{4}$ of a full shingle) is placed so that the lower horizontal edge will be flush with the lower edge of the eaves flashing strip, and the left hand vertical edge flush with the rake end of the eaves flashing strip. It is secured with two nails along both eaves and rake as shown in Fig. 39. Cut shingles are continued along the eaves, end corners in contact, and lower edges secured with three nails evenly spaced along the exposed portion of the lower edge in a row 1" back from the edge of the deck.

In windy locations, a 6" band of special asphalt cement is spread along the eaves edge of the eaves flashing strip. Each unit is bedded firmly in the cement, and secured with a nail in the lower corners of each shingle as shown in Fig. 40.

(b) First Course

The first course is started with a full size shingle from which the interlocking tabs have been cut off. The left corner of the shingle is placed even with the rake edge at such a height that

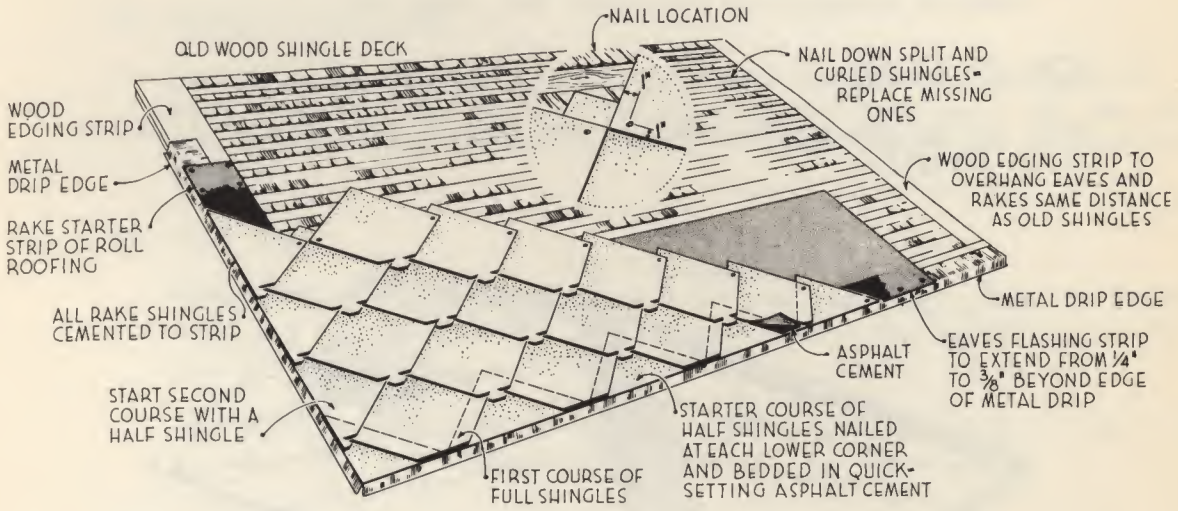


Fig. 40 - Application details for use in windy locations.

the lower cut edge will be flush with the lower edges of the starter course shingles. It is secured in place with a nail in each side corner and in each of the two lower corners as shown in Fig. 39.

In windy locations the lower end of each shingle is set in special asphalt cement spread over the lapped areas of the underlaying starter course shingles. Nails are used only at the side corners. See Fig. 40.

(c) Second & Succeeding Courses

The second course is started with a shingle that has been cut in half vertically, as shown in Figs. 39 and 40. It is located so that the vertical cut edge is even with the rake end of the eaves flashing strip, the remaining locking tab being placed under the edge of the first shingle in the first course, and further secured with nails spaced 4" apart along the rake. Full size shingles are continued across the roof, each locking device being secured to the shingles in the course below. It is important to line the shingles up accurately with the vertical chalk lines, nailing as specified.

The courses are continued up the roof, starting alternately with full and half size shingles aligned along the left rake edge. The left edge of the half shingles is secured along the rake with nails as specified for the starter and second courses.

In windy locations the rake edge is treated as specified for stapled shingles in Paragraph 2-b, Page 43.

4. HIPS AND RIDGES

Hips and ridges are finished in the same manner as specified for strip shingles.

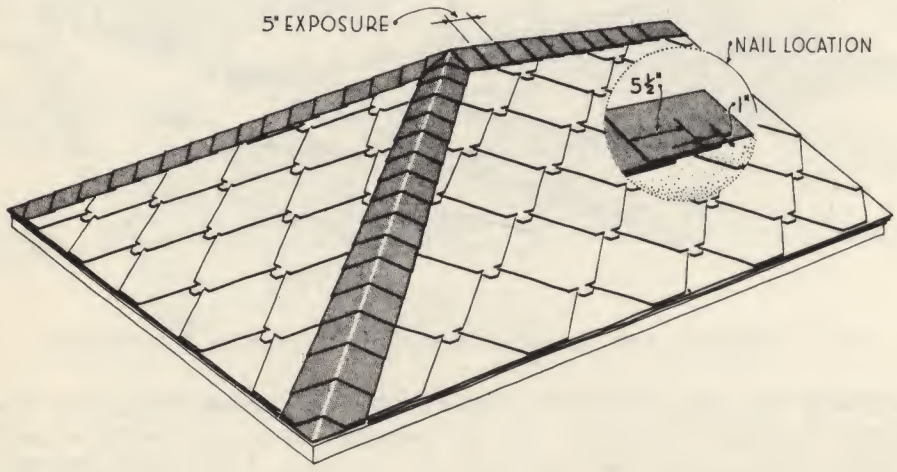


Fig. 41 - Hip and ridge finish with individual hex shingles.

APPLICATION OF GIANT INDIVIDUAL SHINGLES BY THE DUTCH LAP METHOD

1. GENERAL

(a) General Conditions

The Dutch Lap Method of applying Giant Individual Shingles is most commonly used when reroofing over old material. For use in new construction see instructions for American Method application, Page 50.

(b) Roof Deck

Instructions for the preparation of the old deck, given in detail on Pages 23 to 25 should be followed before any shingles are applied.

These shingles should be applied only on decks having a rise of 4" or more per foot of horizontal run.

(c) Acceptable Methods

When applied by the Dutch Lap Method, Giant Individual Shingles may be laid from left to right or from right to left; but never from the center both ways.

(d) Eaves Flashing Strip

An eaves flashing strip is used with these shingles just as for strip shingles and for the same reasons. It should be wide enough to extend at least 12" inside the inside wall line.

(e) Metal Drip Edge

A metal drip edge as described and illustrated on Page 36 is recommended for use with these shingles.

(f) Chalk Lines

Horizontal and vertical chalk lines should always be used to insure good alignment. This is especially important when a dormer or other obstruction intervenes between two ends of a roof, and will insure that the first and succeeding courses above the dormer will line up accurately.

(g) Nails and Nailing

Nails are as specified for other styles of asphalt roofing (See Table II, Page 16). When the application is over old asphalt materials the nails should be 1½" long. When over old wood shingles they should be 1-3/4" long. They should always be long enough to penetrate at least 3/4" into deck sheathing.

Each shingle is secured with two nails and one fastener. When laying from left to right as described herein, the nails are located in the upper left hand corner and in the lower right hand corner. The positions are reversed when laying from right to left. The lower exposed corner is secured to the overlapped portion of the adjacent shingles in the same course with a galvanized wire staple or copper clip as furnished by the manufacturer. Never nail this corner down.

2. APPLICATION

(a) First Course

Start the first course at the lower left (or right) corner of the roof with a piece of shingle 3" wide and 12" high, laid flush with the eave and rake edge of the eaves flashing strip, secured with 4 nails, one in each corner 1" in from each edge. The first full size shingle is placed at the corner of eave and rake to cover and be flush with the outer edge of the 3" x 12" unit, and is secured with nails and fasteners as specified. (See Fig. 42). The course is continued with full shingles, placing each to overlap the shingle just previously applied by 3".

In windy locations the same procedure is followed, but in addition each shingle is embedded in a 6" wide band of a quick setting type of asphalt cement spread over the lower edge of the eaves flashing strip as the work progresses. (See Fig. 43).

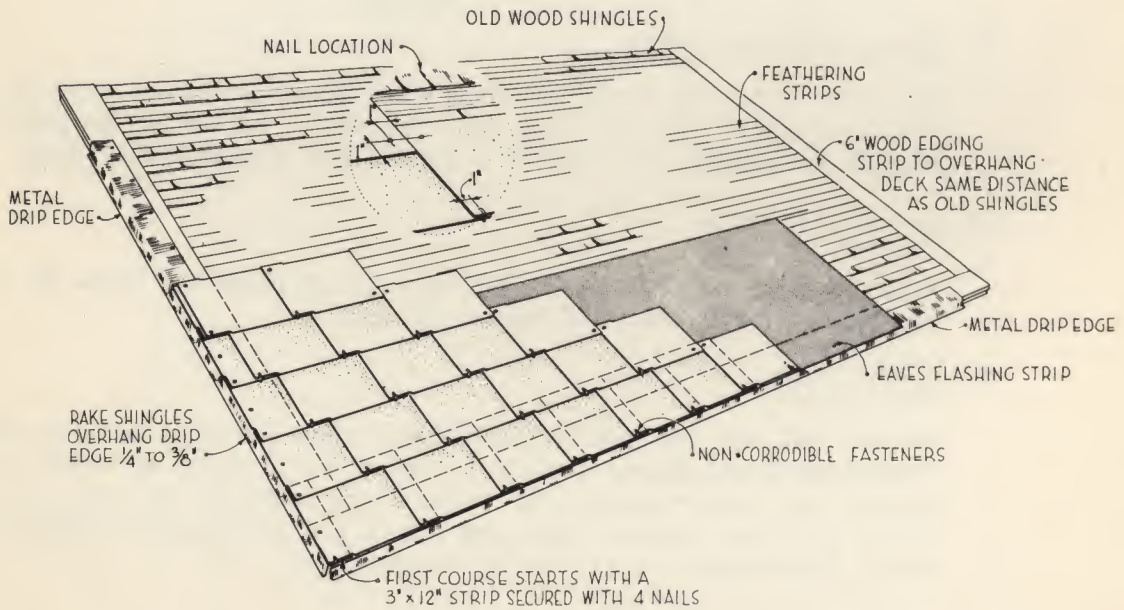


Fig. 42 - Application details for giant individual shingles laid by the dutch lap method.

(b) Second and Succeeding Courses

The second and succeeding courses are self-spacing as to side lap. The second course starts with a full shingle aligned with the vertical exposed edge of the second full shingle in the first course

and placed to overlap the first course 2". The left edge is trimmed even with the rake edge of the eaves flashing strip. The course is then continued with full size shingles, maintaining the 2" headlap and 3" side lap as shown in Fig. 42. The end of the last shingle in each course is trimmed off even with the rake end of the eaves flashing strip, and one exposed nail is placed in the center of each end shingle 1" in from the rake edge of the roof deck.

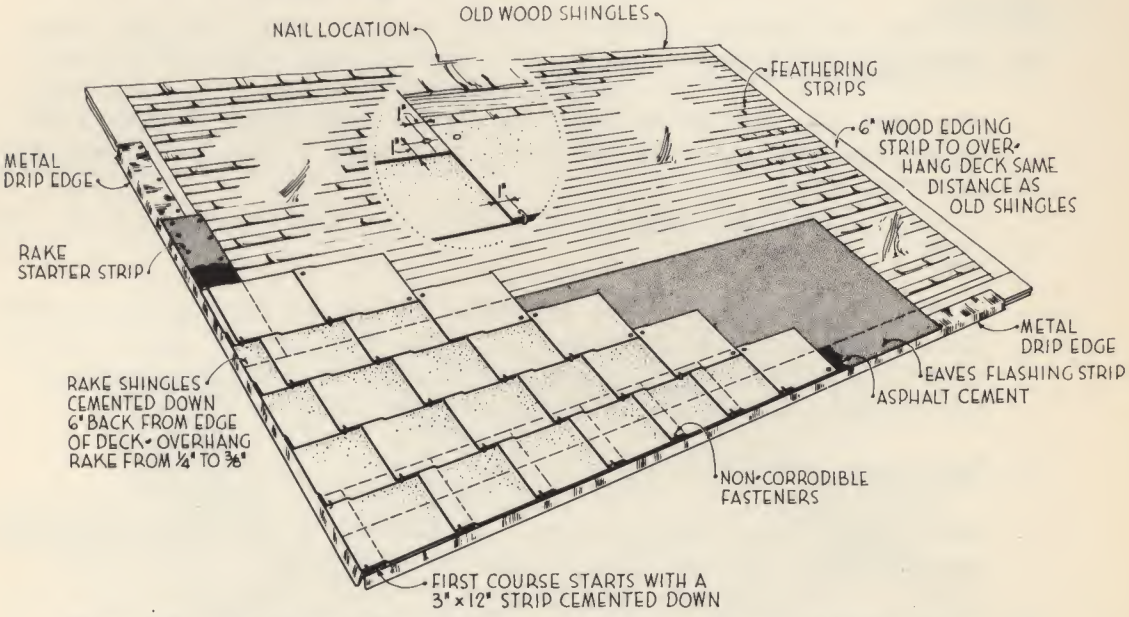


Fig. 43 - Application of giant individual shingles by the dutch lap method in windy locations.

In windy locations it is important to cement down the shingles along the rakes. To provide for this a 6" rake starter strip of 55 lb. roll roofing is applied as described on Page 43 for Individual Hex Shingles. It is covered its full width with special asphalt cement just before starting each course, and the first shingle is embedded firmly in it. Secure the shingle with nails and fasteners as specified for standard practice. (See Fig. 43).

(c) Hips and Ridges

Fig. 44 shows that hips and ridges are finished just as with other styles of asphalt shingles. The regular dutch lap shingle can be used for hip and ridge shingles.

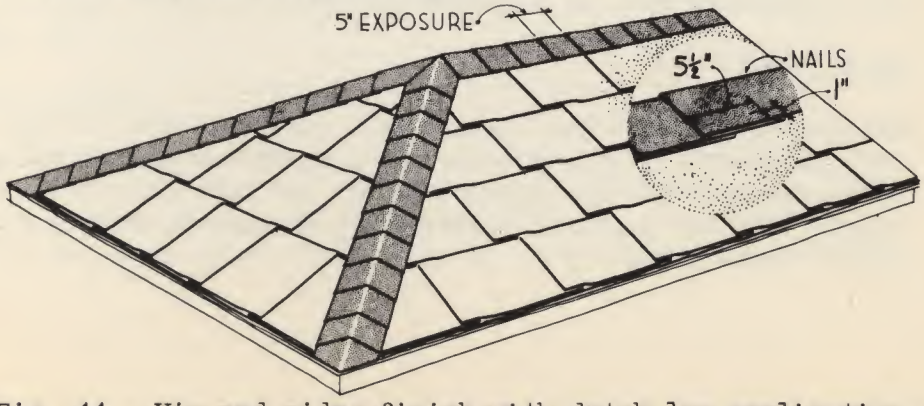


Fig. 44 - Hip and ridge finish with dutch lap application of giant individual shingles.

APPLICATION OF GIANT INDIVIDUAL SHINGLES

BY THE AMERICAN METHOD

1. GENERAL

(a) General Conditions

The American Method of applying Giant Individual Shingles is most commonly used for new work, although it may also be used for reroofing.

(b) Deck

A sound deck as described on Pages 21 and 22 should be assured before any shingles are applied. The deck should have a pitch of not less than 4" rise per horizontal foot of run. Better performance may be expected on steeper slopes.

(c) Exposure

Giant Individual Shingles are recommended to be laid 5" to the weather when the American Method is followed.

(d) Underlayment

When a wood deck is involved, a layer of No. 15 asphalt saturated felt should be applied over it before the shingles are laid. It is important that this underlayment be of vapor permeable material to avoid possible accumulation of moisture or frost between the deck and the underlayment in cold weather. Do not use light weight roll roofing for this purpose.

(e) Drip Edge

A metal drip edge as described and illustrated on Page 36 is recommended for use with these shingles.

(f) Eaves Flashing Strip

An eaves flashing strip is used with these shingles just as for strip shingles and for the same purpose.

(g) Chalk Lines

Horizontal and vertical chalk lines should always be used to insure good alignment. This is especially important when a dormer or other obstruction intervenes between two ends of a roof, and will insure that the first and succeeding courses above the dormer will line up accurately.

(h) Nails and Nailing

Nails shall be as specified for other styles of asphalt roofing. They should be long enough to penetrate to the under surface of the deck but preferably not protrude through it.

Each shingle (except those in the starter course) is secured with two nails, each one located 6" up from the exposed edge and one and one-half inches in from the side.

2. APPLICATION

Fig. 45 illustrates the proper method of applying the shingles.

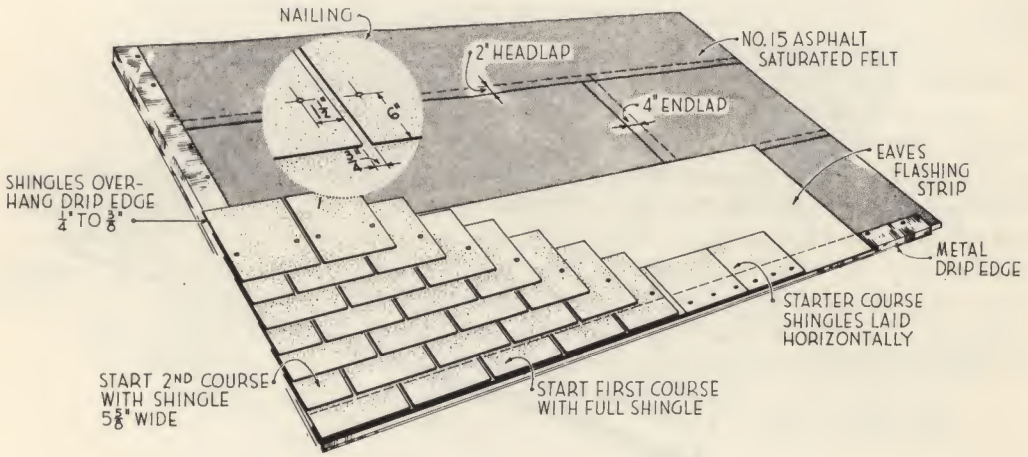


Fig. 45 - Giant individual shingles applied over a new wood deck by The American Method.

(a) Starter Course

A starter course is applied using full size shingles laid with the long dimension parallel to the eaves, so they touch each other but are not forced into tight contact. The starter course is laid flush with the rake and eave edges of the eaves flashing strip. Each shingle is secured with 3 nails as shown in Fig. 45.

(b) First Course

The first course consists of full size shingles, the first shingle being set flush with the rake and eaves edges of the starter course. The succeeding shingles are set flush with the eaves edge of the starter course and spaced either

5/8", 3/4", or 7/8" apart as desired. When spaced 3/4" it requires 226 shingles to cover a square, and the roof weighs 325 lb. per square. Each shingle is secured with 2 nails located as specified.

(c) Second and Succeeding Courses

The second course begins with a shingle whose width is equal to one-half a full shingle minus one-half a joint, and continues with full size shingles properly spaced, thus breaking joints at half points with shingles in the first course. The third course begins with a full shingle, and succeeding courses with cut and full shingles alternately up the roof. (See Fig. 45).

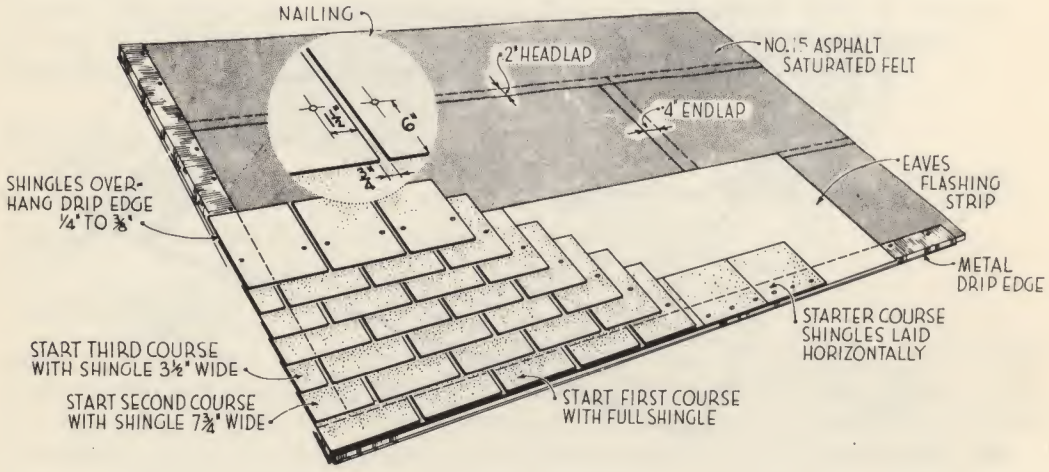


Fig. 46 - Application of giant individual shingles by the American Method. Joints break in thirds.

(d) Alternate Spacing

Somewhat better coverage is obtained if the joints break in thirds instead of halves. To obtain this spacing the second course is begun with a portion of a shingle whose width is equal to two-thirds of a full shingle minus one-third of a joint. The third course begins with a portion of a shingle whose width is one-third of a shingle minus two-thirds of a joint. The fourth course begins with a full size shingle and the sequence is continued up the roof. (See Fig. 46).

(e) Alternate For Windy Locations

Under the center of the exposed portion of each shingle and on the surface of the underlying shingle place a spot of quick setting asphalt cement not less than one-square inch in area.

Press the shingle firmly into the cement, being careful to prevent the cement from squeezing out over the exposed surfaces. Do not bend the shingles back farther than is necessary to place the cement.

(f) Hips and Ridges

Giant Individual Shingles may be used to finish hips and ridges in the same manner as described for strip shingles on Page 40.

(g) Alternate For Low Slope Porch and Dormer Roofs

When the rise is less than 4" per foot on various small sections of the roof, but more than $2\frac{1}{2}$", an additional underlayment of No. 15 Asphalt Saturated Felt is applied by lapping each course 19" over the course below and securing it with nails staggered on 9" centers. Each shingle is secured in place with asphalt cement applied on the back so that it completely covers all but the exposed portion of the shingle. After placing the shingle in position apply two nails about 1" below the top edge and about $1\frac{1}{2}$" in from each side edge. A spot of cement is placed under the center of the exposed portion of each shingle and on the surface of the shingle below. The shingle is then pressed firmly into the cement. It is important to place only enough cement to hold the shingle in place without an excess squeezing out over the exposed surface of adjacent shingles.

APPLICATION OF INTERLOCKING SHINGLES

Interlocking shingles are designed in both single and double coverage patterns. Each style is provided with an integral locking device arranged so that individual shingles can be engaged with others for the purpose of securing proper anchorage without recourse to cement or special fasteners. The locking device is located in the lower portion of the shingle and is a distinctive feature that can be used to classify the numerous designs of lock shingles into four general groups as follows:

TYPE 1 Outside Lock	TYPE 2 Inside Lock	TYPE 3 Combination Outside and Inside Lock	TYPE 4 Side Lock

Fig. 47 - Locking devices used in interlocking shingles.

1. GENERAL

(a) General Conditions

These shingles are used for both new and reroofing work.

(b) Deck

A sound deck, as described on Pages 21 through 24, should be assured before any shingles are applied. The deck should have a pitch of 4" rise or more per horizontal foot of run.

(c) Direction of Application

Except for Type 4 (Dutch Lap), interlocking shingles may be laid from left to right, from right to left, or from the center each way. If it is desired that both rakes present the same appearance, then the center starting method must be used. Dutch Lap, Type 4, must start at one end or the other and proceed to the opposite end, the location of the locking device on the shingle determining the direction of application.

(d) Underlayment

When a new wood deck is involved, a layer of #15 asphalt saturated felt should be applied before any shingles are laid. It is important

that this underlayment be of vapor permeable material to avoid possible accumulation of moisture or frost between the deck and the underlayment in cold weather. Do not use light-weight smooth roll roofing for this purpose.

(e) Drip Edge and Eaves Flashing Strip

The metal drip edge and eaves flashing strip, as described and illustrated on Page 36, are recommended for use with these shingles.

(f) Chalk Lines

It is recommended that sufficient horizontal and vertical chalk lines be used to obtain good alignment even though the locking devices might be presumed to provide for automatic alignment. This is especially important when a dormer or other obstruction intervenes between two ends of a roof, and will help to insure accurate placement of the shingles in the courses above the dormer.

(g) Nails

The humber and position of nails for each shingle are specified on the manufacturers direction sheet. Direction sheets should be carefully studied and followed not only in respect to nails, but also as to other important features of application.

2. APPLICATION

(a) Starter Strip

If the eaves flashing strip is of smooth roll roofing, a starter strip will be needed at least 9" wide and cut from mineral surfaced roll roofing of the same color as the shingle. This is true of all except Type 4 and some of the type 1 shingles.

If the eaves flashing strip is of mineral surfaced roll roofing the same color as the shingles, the starter strip may be omitted.

(b) Types 1-2-3 - End and Center Starting Methods

(1) First Course

First course shingles are applied starting either from an end or from the center, as desired, so that only that portion of the shingle which is required to provide for proper locking of the second course shingles lies on the deck. The lower portion, which then overhangs the eaves, is cut off even with the lower edge of the eaves flashing strip. These first course units must be applied to allow for the irregularities of the deck and for the tolerance provided by the design of the locking device. The lateral edges of the shingles shall touch but it is important to avoid forcing them into tight contact. The shingles are secured with nails at points specified by the manufacturer.

(2) If the center starting method is used, a vertical chalk line is applied to the deck midway between the two rakes. The first course starts with a unit centered on this chalk line and the application proceeds in both directions to the ends of the deck, where the end units are trimmed to project beyond the drip edge 1/4" to 3/8".

(3) Second and Succeeding Courses

The second and succeeding courses are of full size shingles, each being locked in a manner appropriate to the design of the shingle, as illustrated by the examples shown in Fig. 48. Shingles are aligned vertically so that they are perpendicular to the eave and ridge, and so that the side edges of shingles meet just as in the first course. At the rake the shingles are trimmed to overhang the drip edge 1/4" to 3/8", and secured either with face nails or quick setting asphalt cement.

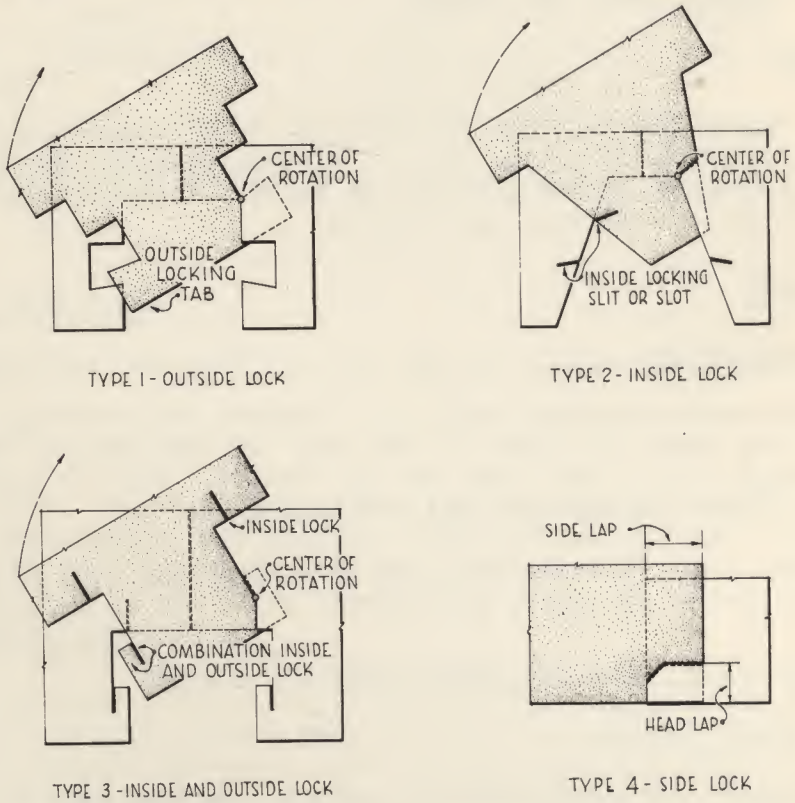


Fig. 48 - Methods of locking shingles of Types 1-2-3 and 4.

(c) Type 4 - End Starting

First and Succeeding Courses

The first course starts with a piece of shingle 3" wide and 12" high, laid flush with the eave and rake edges of the eaves flashing strip, and secured with four nails, one in each corner 1" in from each edge. The first full size shingle is then placed at the corner

of the eave and rake to cover and be flush with the outer edges of the 3" x 12" unit and is secured with two nails located as specified by the manufacturer. The free lower corner is fastened either with a face nail or with a spot of quick setting asphalt cement. The course is completed with full shingles secured by nails and the locking device as specified by the manufacturer and shown in Fig. 48 - Type 4. Succeeding courses are placed to provide the head lap specified and the side lap imposed by the design of the locking device.

3. HIPS AND RIDGES

For finishing hips and ridges use "Hip and Ridge" shingles as supplied by the manufacturer. Hip and ridge shingles may be cut from the roofing shingles or from 90 lb. mineral surfaced roll roofing if desired.

Do not use metal ridge roll as corrosion may discolor the roof. Bend a shingle lengthwise so as to have equal exposure on each side of the hip or ridge, and expose the shingle 5". Secure the shingle with one nail on each side of the hip or ridge, located 5-1/2" from the exposed end 1" from the edge. In cold weather warm the shingle before bending.

The method illustrated for strip shingles on Page 40 is applicable to interlocking shingles.

ROLL ROOFING

1. GENERAL

(a) It is not good practice to apply roll roofing at temperatures below 45° F. When it is necessary to handle the material at that or lower temperatures it should be warmed before unrolling, in order to avoid cracking.

Roofing should be cut into 12' - 0" to 18' - 0" lengths which should then be spread on a smooth surface until they flatten out.

(b) Windy Locations

The following roll roofings are recommended for use in windy locations when they are applied according to the specifications included herein:

1 - Pattern Edge - Blind Nailed
2 - 18" wide 90# Mineral Surfaced or 65# Smooth - Blind Nailed
3 - 19" Selvage Double Coverage

(c) Decks and Flashings

Instructions for roof decks and flashings as outlined on Pages 20 to 35 should be carefully followed when applying roll roofing.

(d) Roof Pitch

Assuming the deck supporting construction to be such that sufficient settling to cause puddles of water to stand after a rain is unlikely during the life of the structure, the following minimum roof pitches are safe for the type of application indicated:

1 - Exposed Nail Method, 2" headlap - 3" per horizontal foot of run
2 - Blind Nail Method, 3" headlap - 2" per horizontal foot of run
3 - Double Coverage, 19" Selvage - 1" per horizontal foot of run

(e) Cement

Use only lap cement for exposed nail application and a quick setting type of special cement as recommended by the manufacturer for blind nail application. Cement should be kept in a warm place before using. If necessary to warm quickly, place the unopened container in hot water. Never heat any kind of asphalt cement directly over a fire.

(f) Nails

For application directly to a wood deck use 7/8" or 1" galvanized roofing nails having large heads (at least 3/8" in diameter). Over old roofing use nails long enough to penetrate the old material and into the roof sheathing at least 3/4". Drive nails straight to avoid cutting the roofing with the edge of the nail head. Do not sink the nail head into the surface of the roofing.

APPLICATION OF 36" ROLL ROOFING

1. EXPOSED NAIL METHOD, PARALLEL TO EAVES (See Fig. 49)

(a) First Course

Apply the first course full width of the roll, so that the lower edge and end will extend over the eave and rake from $\frac{1}{4}$ to 3/8". Nail along a line from $\frac{1}{2}$" to 3/4" down from the top edge every 18" to secure it while the second course is being placed. Nail along eave and rake on a line approximately 1" in from the edge of the roofing, the nails to be spaced on 2" centers and slightly staggered.

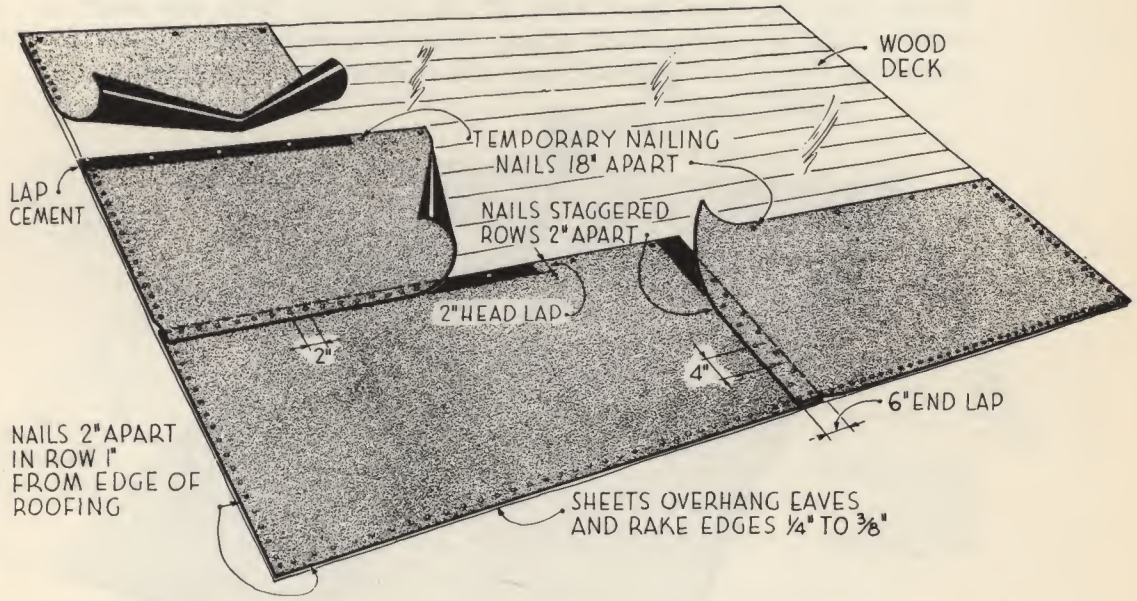


Fig. 49 - Exposed nail application of roll roofing parallel to the eaves.

(b) Second Course

Apply the second course so that it will lap the first course 2", and nail it along the top edge with nails spaced 18" apart as specified for the first course. Lift the lower edge of the overlapping sheet and apply lap cement over the upper 2" of the lower course. Embed the overlapping sheet in the cement and nail through the lap on 2" centers. Be sure the nail passes through the cement. Stagger the nails slightly to avoid splitting the roof deck placing them not less than 3/4" up from the exposed edge of the sheet. The rake is nailed as specified for the first course. To make a satisfactory lap it is important that the entire lap area be covered with cement and firmly pressed together.

(c) Succeeding Courses

Continue in like manner up the roof, trimming the last sheet even with the ridge.

2. EXPOSED NAIL METHOD, PARALLEL TO THE RAKE (See Fig. 50)

(a) General

Start at one end of the ridge and use strips that have been cut to allow the lower end to project $\frac{1}{4}$" to 3/8" over the eaves.

(b) First Course

The first strip is placed so that it overhangs the rake and eaves $\frac{1}{4}$" to 3/8". It is nailed every 6" along the ridge and every 18" along the lap edge on a line $\frac{1}{2}$" to 3/4" in from the edge of the sheet. Nails are placed along rake and eaves on a line 1" in from the edge of the roofing, and spaced on 2" centers.

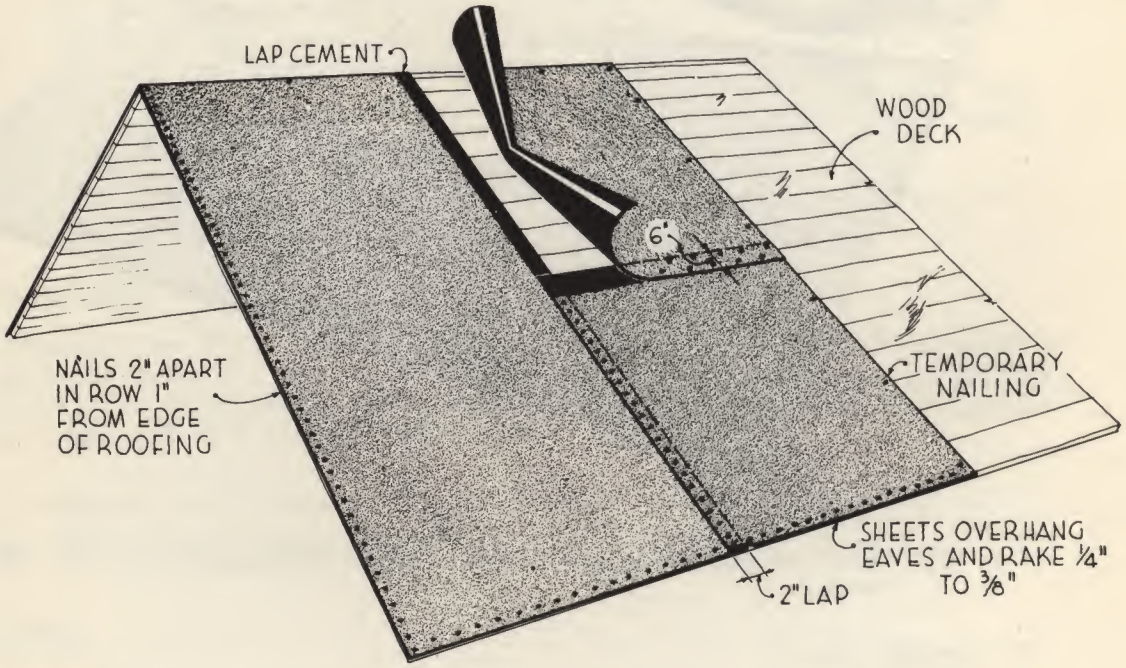


Fig. 50 - Exposed nail application of roll roofing parallel to the rake.

(c) Second Course

The second course is applied in the same manner as specified for the first course, overlapping the first course 2". The lapping sheet is lifted and lap cement applied over the side 2" of the underlying sheet. The overlapping sheet is then embedded in the cement and nailed through the lap 3/4" from the exposed edge of the sheet, spacing the nails on 2" centers and making sure that they pass through the cement. The purpose of driving the nail through the cement is to seal the nail hole.

(d) Succeeding Courses

Courses continue in like manner across the roof, the last sheet being trimmed to overhang the rake from $\frac{1}{4}$" to 3/8".

(e) End Laps

All end laps are 6" wide and cemented the full width of the lap. Two rows of nails are applied, one 1" and the other 5" from the exposed edge of the overlapping sheet as shown in Figs. 49 and 50. The nails are spaced on 4" centers and are staggered with respect to the nails in the other row.

End laps are staggered so that in no case shall an end lap in one course be over or adjacent to an end lap in the preceding course.

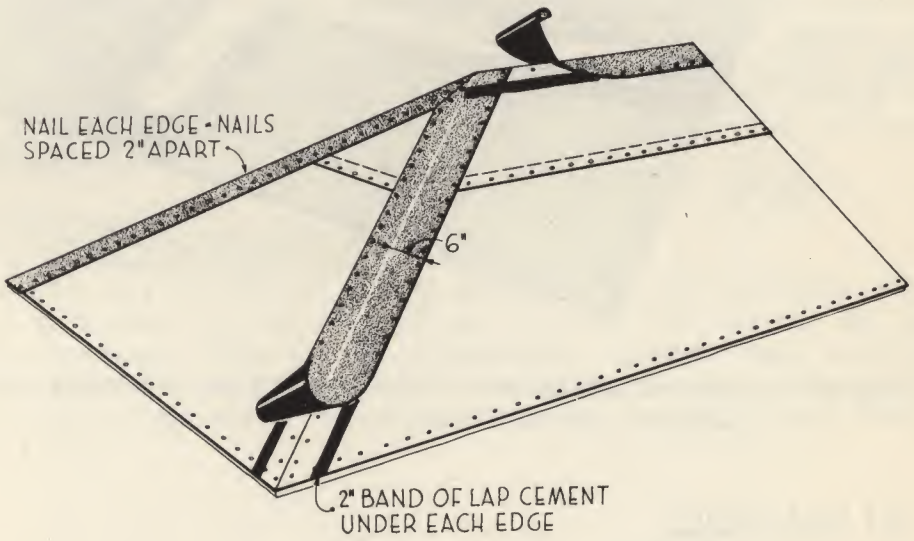


Fig. 51 - Finish for hips and ridges when laying roll roofing by the exposed nail method.

(f) Hips and Ridges (See Fig. 51)

To finish hips and ridges, proceed as follows: Trim the sheets of roofing even with the hips or ridges; butt them and nail them as specified.

Cut a strip of roll roofing 12" wide and long enough to extend from one end of the hip or ridge to the other. Bend it along its lengthwise center line so that it can be laid over the hip or ridge and will extend 6" down on each side. Snap a chalk line $5\frac{1}{2}$" down from the peak on each side of the hip or ridge and apply a 2" wide band of lap cement along each side so that its lower edge will be even with the chalk line. Place a strip over the hip or ridge, embedding it firmly into the bands of cement, and nailing through the cement on 2" centers along a line 3/4" above the edges of the strip.

3. CONCEALED NAIL METHOD, PARALLEL TO THE EAVES

(a) Starter Strips (See Fig. 52)

9" wide starter strips are applied along eaves and rakes placed to overhang the edge of the deck ¼" to 3/8". They are secured with two rows of nails 1" in from each edge, the nails to be 4" apart in the rows. As the work progresses the strips are covered completely with a special quick-setting type of asphalt cement as recommended for the purpose by the manufacturer.

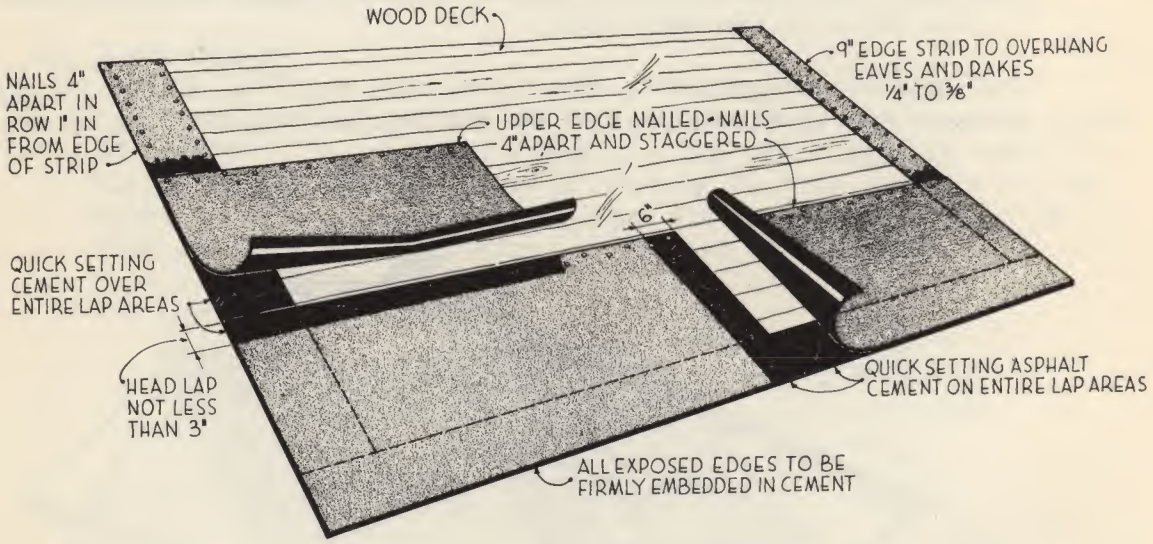


Fig. 52 - Application of roll roofing by the concealed nail method parallel to the eaves.

(b) First Course

The first full width strip of roofing is applied so that its rake and eaves edges will be flush with the outer edges of the starter strips. Before the starter strip is covered with cement, the upper edge of the full width strip is secured with a row of nails spaced 4" apart and slightly staggered, and so located that the next course will overlap them by not less than 1". No nails are applied within 18" of the rake edge until after the cement is spread over the starter strip.

(c) Second and Succeeding Courses

The second and succeeding courses are applied to overlap each preceding course by a predetermined lap, but not less than 3", and are secured along the upper edges, (except within 18" of the rake edge) with nails located as prescribed for the first course.

(d) Application of Cement

Lift the lower edge of each course, as well as the end overlapping the rake starter strip, and apply the special asphalt cement in a continuous layer over the full width of each lap. Press the overlapping edges firmly into the cement until a small bead appears along the edges of the sheet, applying the pressure evenly and firmly over the entire cemented area. This is the most important detail of the application process.

(e) Check-Up

Before leaving the job check back over the laps and press down those that may have pulled away, re-cementing where necessary to secure a good bond.

(f) End Laps

All end laps are 6" wide, as specified for exposed nail application (See Page 61). The cement is spread over the entire lapped area after the lapped course is nailed with two rows of nails. The nails are located as specified for the exposed nail method, except that they penetrate the lapped course only, and are covered or concealed by the cement and the overlapping course.

(g) Hips and Ridges (See Fig. 53)

The sheets are butted and nailed as they come up on either side of a hip or ridge. Strips of roofing 12" x 36" are cut for hip and ridge covering. They are bent lengthwise through their centers, and shingled to the hip or ridge, beginning at the lower end of a hip or at either end of a ridge. Each one overlaps the preceding one by 6".

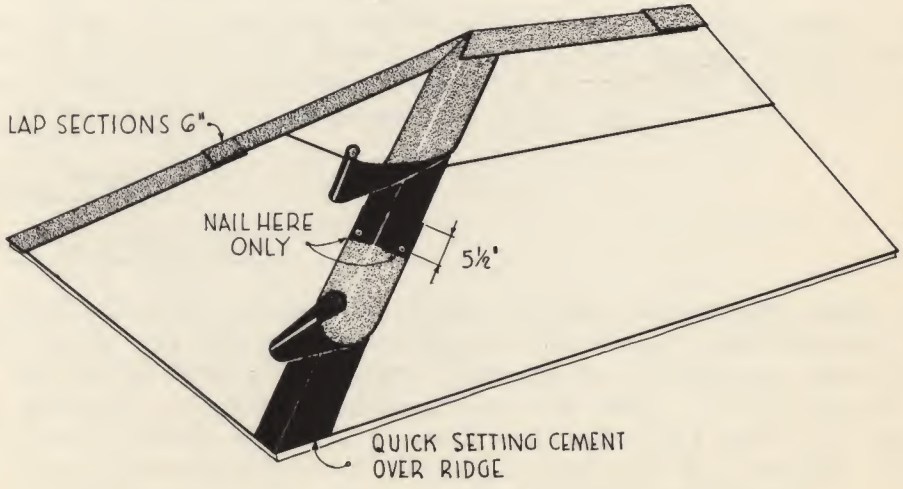


Fig. 53 - Finish for hips and ridges when roll roofing is applied by the concealed nail method.

Before applying 12" x 36" pieces, the following steps are taken:

1. A chalk line is snapped on each side 5½" below the peak.

2. Special quick-setting cement is then applied over the peak from one chalk line to the other.

The first shingle unit is then pressed into the cement and secured with two nails 5½" from the end which is to be lapped as shown in Fig. 53. As the work progresses, cement is spread over the entire portion of each shingle which is to be lapped, before the next one is applied. The overlapping end of each succeeding shingle is pressed into this cement, and the process repeated to the end of the hip or ridge.

4. CONCEALED NAIL METHOD, PARALLEL TO THE RAKE

In general, the specifications for horizontal application apply to vertical application except that the sheets are started from the ridge, where they are secured at the top with 3 or 4 nails, and unrolled toward the eaves. Sheets should be permitted to hang free until they lie smoothly before they are nailed and the laps cemented.

5. APPLICATION OF 18" OR 19" WIDE ROOFING

(a) Narrow roll roofing (18" or 19" wide) is applied by the concealed nail method just as specified for the wider sheets except that the headlap in all cases is limited to a minimum of 3".

(b) Only narrow roll roofings, equivalent to 65# Smooth or heavier, or 90# Mineral Surfaced, or heavier, and applied according to the foregoing specifications are recommended for use in windy locations.

APPLICATION OF PATTERN EDGE ROLL ROOFING

1. GENERAL

In addition to the general specifications covering all roll roofings as set forth on Page 58, the following considerations are important when applying Pattern Edge Roll Roofing:

(a) Separating the Sheet

The roofing should be unrolled on a smooth surface and carefully separated into two parts along the partially cut pattern line at the center of the roll. It should never be separated by breaking across a plank or ridge.

(b) Direction of Lay

Pattern Edge Roll Roofing should always be laid parallel to the eaves.

(c) Selection of Method of Application

The exposed nail method is recommended only in reroofing over old roofing materials. The concealed nail method, involving the use of special cement, is generally preferred.

(d) Pitch Limitation

When Pattern Edge Roll Roofing is applied by the exposed nail method, it is recommended that it be used only on roofs having a rise of at least 4" per foot of horizontal run.

(e) Spacing of Tabs and Cutouts

Pattern Edge Roll Roofing may be applied so that the tabs of one course will be centered over the tabs of the course below, as shown in Fig. 54, or so that they will be centered over the cutouts of the course below as shown in Fig. 56.

2. EXPOSED NAIL METHOD

(a) Starter or First Course

The first strip is applied reversed so that the pattern edge is up the roof, and the straight edge is parallel to and extends over the eaves from $\frac{1}{4}$" to 3/8". The end is trimmed so that the sheet projects a like distance beyond the rake. It is nailed along the top with one nail in each tab and along eave and rake on a line approximately 1" in from the edge of the roofing, the nails being spaced on 2" centers and slightly staggered.

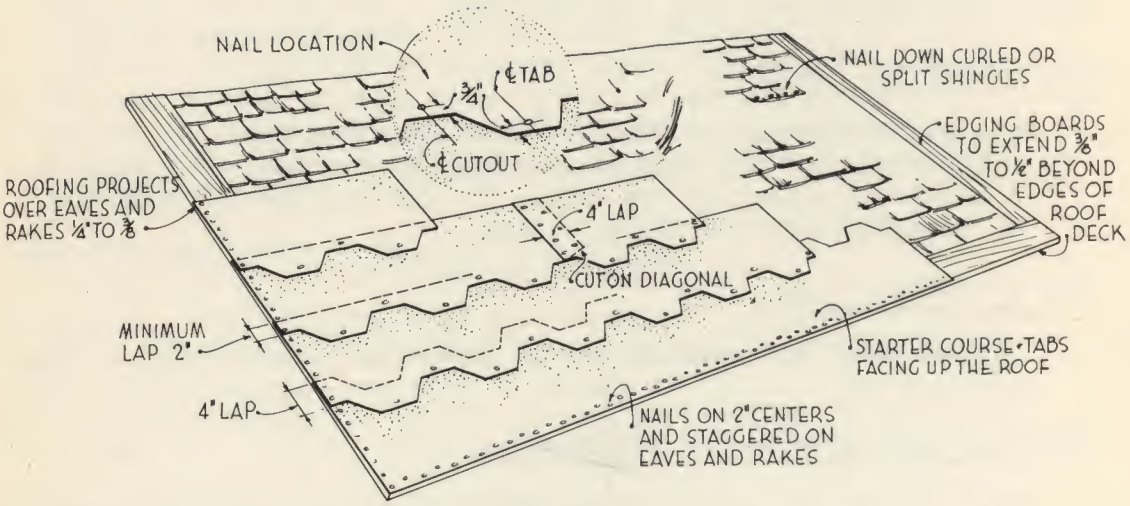


Fig. 54 - Application of pattern edge roll roofing by the exposed nail method.

(b) Second Course

The second course is applied pattern edge down the roof, so that the tabs are centered over the cutouts of the reversed starter course. The course laps the first course at least 4" as shown in Fig. 54. It is secured with a row of nails located 1" down from the upper edge, each nail being placed directly over the middle point of each tab. Nails are applied along the pattern edge, each one located on the center line of each tab and cutout, and about 3/4" above the lower edge. Rake edges are nailed along a line approximately 1" in from the edge of the roofing, the nails being located on 2" centers and slightly staggered.

(c) Succeeding Courses

The courses are continued in like manner up the roof, each course being lapped by not less than 2" measured from the cutout to the upper edge of the underlying course, and nailed as specified for the second course. The last course is trimmed even with the ridge.

(d) Application With Clips or Fasteners

Pattern Edge Roll Roofing is sometimes applied with clips or fasteners manufactured for the purpose. The method is the same as described here for the exposed nail method except that fasteners are used at all places where exposed nails are specified at cutouts and tabs. The clips are secured to the roof deck under the pattern edge and are then bent over the exposed edge at the tabs and cutouts to hold the strips in place.

(e) End Laps

End laps are at least 4" wide. The underlying sheet is cut diagonally upward from the center of the cutout as shown in Fig. 54, and the overlapping sheet is brought to this same point. Nails are applied in two rows, 1" and 3" from the end of the overlying sheet, and spaced 4" apart in the rows. End laps are staggered as specified for 36" roll roofing application.

(f) Hips and Ridges

Hips and ridges for exposed nail application of Pattern Edge Roofing are treated in the same manner as specified for 36" Roll Roofing, and as illustrated on Page 61, except that no cement is used.

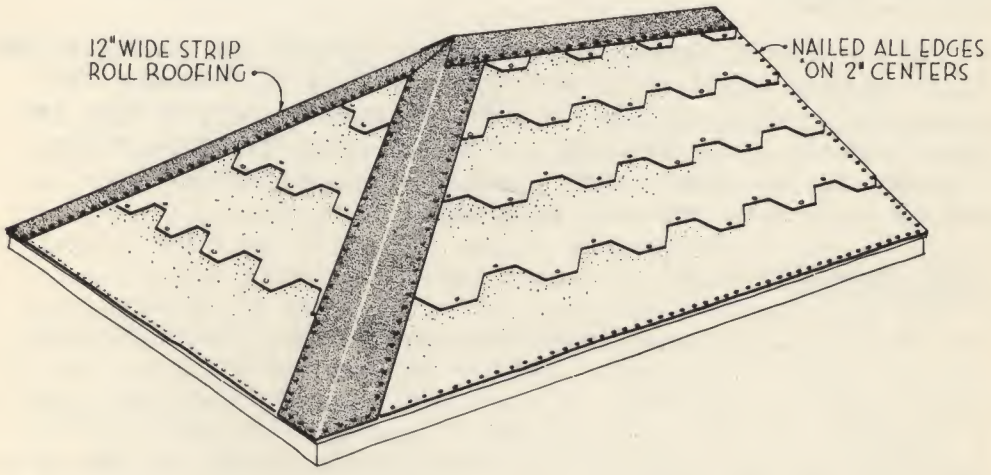


Fig. 55 - Treatment of hips and ridges.

3. CONCEALED NAIL METHOD

(a) Use

When applied by the concealed nail method Pattern Edge Roll roofing may be used for both new work and for reroofing over old materials.

(b) Pitch

Where a 3" headlap is used, Pattern Edge Roll Roofing may be applied on decks having a rise of 2" per horizontal foot of run or more. Where a 4" headlap is used the minimum acceptable rise per foot of run may be reduced to 1½".

(c) Cement

Only a special quick setting type of cement recommended by the manufacturer should be used.

(d) Starter Strips

9" wide strips of Smooth Roll Roofing, (55 lb. or heavier), are first applied along eaves and rakes, placed to overhang the edges of the deck from ¼" to 3/8". They are secured with two rows of nails 1" in from each edge and end, the nails being 4" apart in the rows. They are completely covered with special cement as the work progresses.

(e) First Course

The first course consists of a reversed strip placed with the pattern edge up the roof. Before the starter strip is covered with cement the top edge of the first course is secured with a staggered row of nails spaced 4" apart, so located that no nail will be more than 2" below the cutout portion of the sheet. Nails are not applied closer than 18" to the rake until the cement is in place. The cement is then spread over the starter strip, after which the lower edge and rake ends of the first course are pressed firmly into the cement. See Fig. 56.

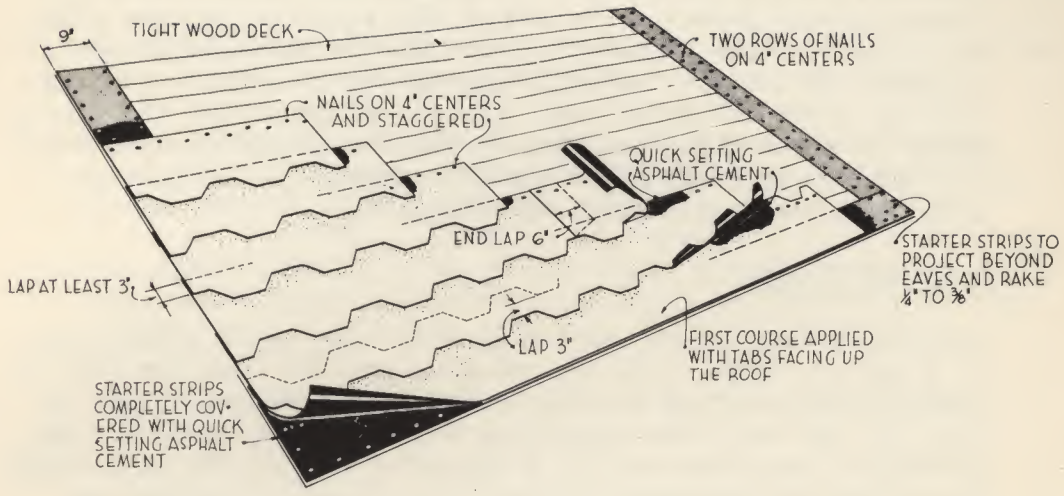


Fig. 56 - Application of Pattern Edge Roll Roofing by the concealed nail method.

(f) Second and Succeeding Courses

As illustrated in Fig. 56, the second course is applied pattern edge down the roof, so that tabs are centered over the cutouts of the reversed starter course. The second and succeeding courses lap each preceding course a predetermined amount, but never less than 3". Each course is secured with a staggered row of nails along its upper edge, the nails spaced on 4" centers and so located that no nail will be less than 3/4" or more than 2" from the top edge of the sheet.

(g) Application of Cement

The lower edge of each course is lifted and special cement applied in a continuous layer over the full width of the headlap. The overlapping edges are pressed firmly into the cement so that a small bead appears along the edge of the cutout portion.

(h) Check-Up

Before leaving the job it is desirable to check back over all laps and press in those that may have pulled away, re-cementing where necessary to secure a good bond.

(i) End Laps

End laps are 6" wide. As specified for exposed nail application the underlying sheet is cut diagonally upward from the center of the cutout. The end of the sheet is secured with two rows of nails 1" and 5" back from the end. Nails are 4" apart in the rows. Cement is spread over the full width of the lap. The overlying sheet is cut off square at the center point of a cutout and applied at the center of the cutout in the underlying sheet where the lap starts. It is pressed uniformly into the cement. See Fig. 56.

(j) Hips and Ridges

Courses are butted and nailed as they come up on either side of a hip or ridge. The hip shingles are cut from the roll of pattern edge roofing as illustrated by the shaded detail in Fig. 57, and are bent lengthwise through their centers. Beginning at the lower end of a hip or at either end of a ridge, the pieces are shingled to the hip or ridge proceeding as follows:

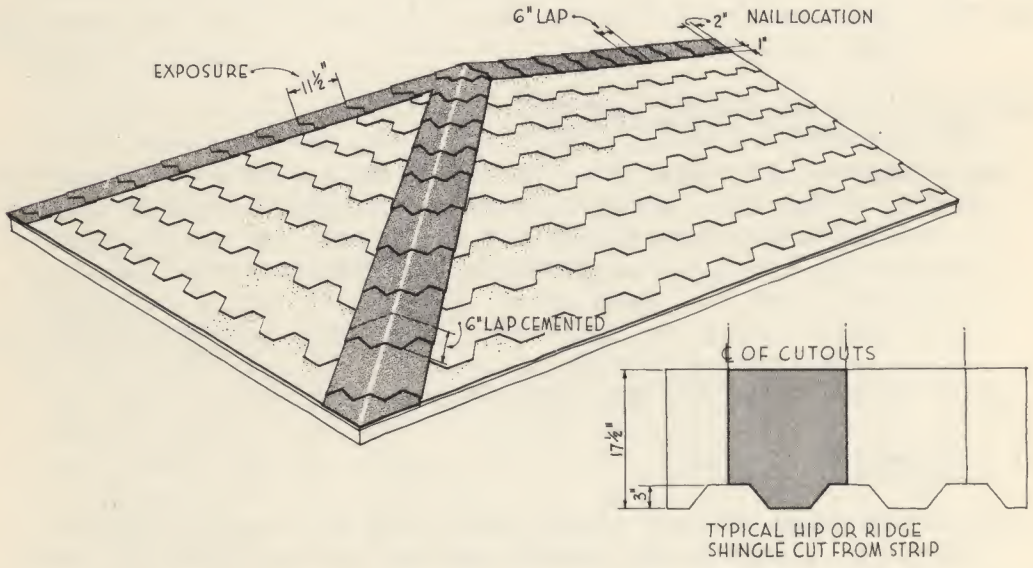


Fig. 57 - Treatment of hip or ridge.

(1) A chalk line is snapped on each side of the peak a distance away equal to one-half of a shingle minus 1/2".

(2) Special cement is applied over the peak and down on each side to the chalk line.

(3) The first shingle is applied at the lower end of the hip or at either end of the ridge and pressed firmly into the cement.

(4) The shingle is secured with one nail on each side 5½" in from the end which is to be lapped and 1" up from the edge.

(5) The end of the first shingle is then covered with special cement for a distance equal to the extent of the lap and in a manner to conform to the pattern edge of the shingle.

(6) The second shingle is placed to cover the first and pressed into the cement, thereafter nailing it as specified for the first.

(7) The process is continued to the end of the hip or ridge.

APPLICATION OF 19" SELVAGE DOUBLE COVERAGE ROLL ROOFING

1. GENERAL

(a) 19" Selvage Double Coverage Roll Roofing is uniformly produced as a 36" wide sheet, 17" of which is mineral surfaced and 19" unsurfaced. The 19" selvage or unsurfaced portion is variously finished by different manufacturers. Some saturate the sheet, some saturate and coat the sheet, and others modify in other minor ways. Some of these products may be applied with cold asphalt adhesives, some only with hot asphalt, and some with either. It is important to know the type of product being used in each instance and to follow the manufacturers' directions explicitly as to the type of cementing agent to use.

(b) General considerations covering handling of the rolls and cements, preparation of decks, nail lengths and other features as detailed on Page 58, in connection with roll roofing apply to Double Coverage material and should be observed.

(c) Roof Pitch

This roofing may be used on roofs having a rise of 1" per foot of horizontal run or more.

2. APPLICATION (parallel to eaves)

(a) Metal Drip Edge

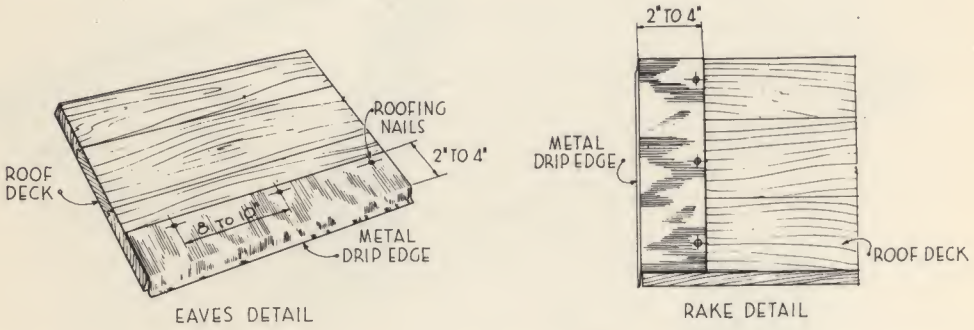


Fig. 58 - Application of metal drip edge at eaves and rakes

Along the eaves and rakes a drip edge similar to that shown on Page 36 is used. It is applied directly to the wood deck as shown in Fig. 58.

(b) Starter Strip

The starter strip, laid along the eaves, consists of the unsurfaced portion, or 19" selvage edge, cut from a strip of roofing. It is applied so that it projects $\frac{1}{4}$" to 3/8" beyond the edge of the metal drip at eaves and rakes. It is secured to the deck with two rows of roofing nails, one 4-3/4" below the upper edge and the other about $1\frac{1}{2}$" above the lower edge, the nails 12" apart in the upper row and 4" apart along eaves and rakes.

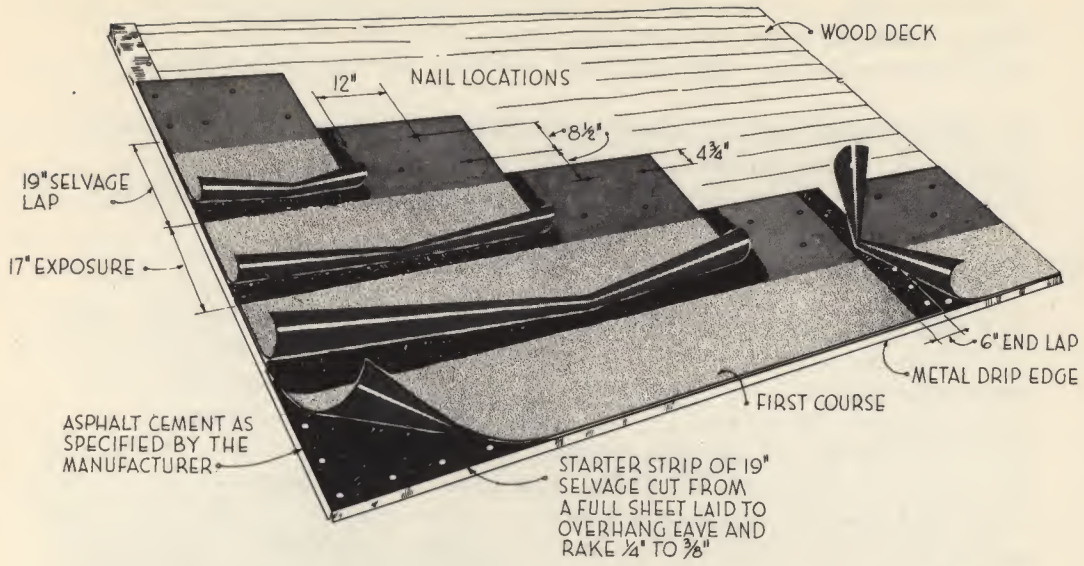


Fig. 59 - Application of double coverage roll roofing parallel to eaves.

(c) First Course

The first course is applied with the end and lower edge flush with the rake and eave edges of the starter strip, and secured with two rows of nails, the first from $1\frac{1}{2}$" to $6\frac{1}{2}$" (preferably 4-3/4") below the upper edge, and the second $8\frac{1}{2}$" below the first. The nails are 12" apart in the rows and staggered. When the preferred spacing is used as shown in Fig. 59 uniform nail spacing occurs over the entire roof deck.

(d) Succeeding Courses

Several courses are then applied, each one lapping the preceding course the full width of the selvage edge, and being nailed as specified for the first course, through the selvage portion only.

(e) Application of Cement

A suitable asphalt adhesive, either cold or hot, and in an amount specified by the manufacturer of the roofing being applied, is used to cement the sheets together. Generally cold cement is applied at the approximate rate of 20 lbs. per square, and hot asphalt at the approximate rate of 35 lbs. per square, but the specific recommendation of the manufacturer must be observed to get the best results.

The mineral surfaced part of each sheet is lifted and the cementing material is spread evenly over the selvage portion of the underlying sheet, using a roofers brush, squeegee, mop or comb trowel. The overlying sheet is then pressed firmly into the cement, using a broom or light roller to apply pressure evenly over the entire area so that complete contact between the sheets is secured at all points. The cement is spread

close enough to the exposed edge of each sheet to produce a small bead when it is pressed home, but not so close that it will flow out over the exposed portion of the lower sheet.

On low pitched roofs, some applicators prefer to roll the sheets in place after the cement has been spread, in much the same manner as the plys of a built-up roof are laid.

(f) End Lap (See Fig. 60)

All end laps are 6" wide. The overlapped portion of the sheet is first secured to the deck with a row of nails located 1" in from the end of the surfaced portion of the sheet, the nails being spaced 4" apart in the row. (See Fig. 60, Step 1). Asphalt cement is spread evenly over the full width of the lap as shown in Step 2, Fig. 60, and the overlying sheet is brought down and pressed into the cement. The overlying sheet is then secured to the deck with a row of nails located 1" in from the end of the sheet, driven through the unsurfaced or selvage portion of the sheet only, the nails being spaced on 4" centers. (Shown in Step 3).

End laps are staggered just as in the case of ordinary roll roofing.

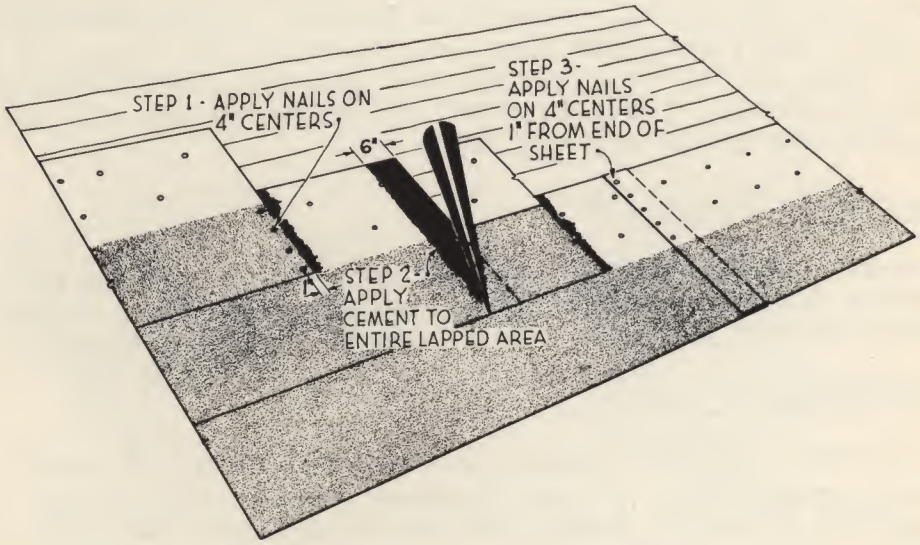


Fig. 60 - Construction of the end lap shown in 3 steps.

3. APPLICATION (parallel to the rake)

(a) Metal Drip Edge

The metal drip edge is used as specified in 2-(a) above.

(b) Starter Strip

The starter strip is as described for horizontal application, but applied parallel to the rake and so placed as to be even with the ridge and to overhang both rake and eaves from $\frac{1}{4}$" to 3/8".

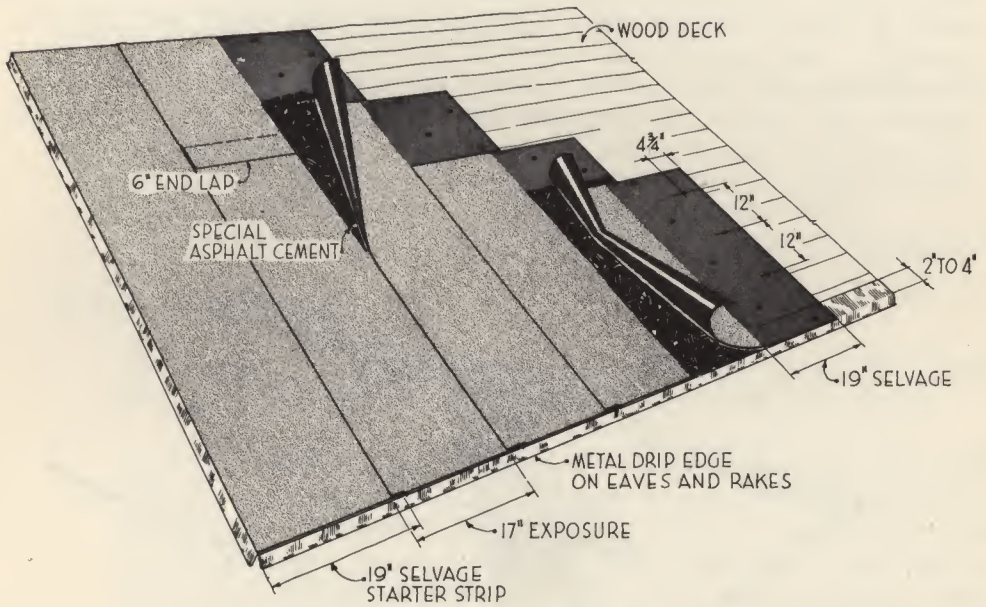


Fig. 61 - Application of double coverage roll roofing parallel to the rake.

(c) First and Succeeding Courses

The first course is applied starting at the eaves as shown in Fig. 61 with one end, if long enough, even with the ridge and with the mineral surfaced portion completely covering the starter strip. Nails, in the selvage portion only, are spaced as specified in 2-(c) Page 73. Several courses are applied in like manner as shown in Fig. 61.

(d) Application of Cement

Cement is applied and the process completed as specified for the horizontal method of application.

4. HIPS AND RIDGES

(a) The sheets are butted and nailed as they come up on either side of a hip or ridge.

(b) Ridge shingling units are prepared by cutting strips of roofing 12" wide from the roll, across the sheet, and bending them lengthwise through their centers.

(c) Beginning at the lower end of a hip or at either end of a ridge, the pieces are "shingled" to the hip or ridge by lapping each one 19" over the preceding one. The first section, consisting of the selvage portion only, is set in a band of cement applied along the hip or ridge for a distance of 6" down from the angle of the roof on both sides. It is secured with 3 or 4 nails on each side, 1" from the edge and spaced evenly. The second and succeeding units, consisting of full length strips, are set to cover the selvage portion of the underlying strip and secured in each case with asphalt cement and nails in the selvage portion only as specified for the first strip. See Fig. 62.

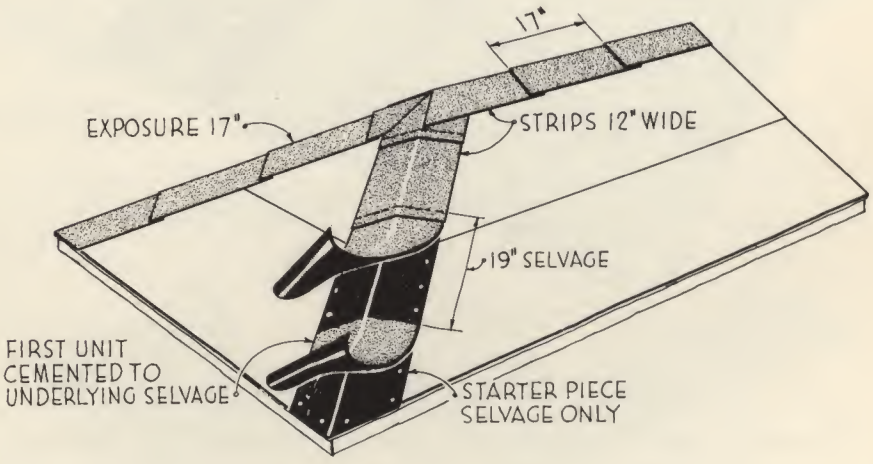


Fig. 62 - Treatment of hip and ridge.

5. INSPECTION

Before leaving a completed job it is a good practice to inspect each lap to be sure that the edges of the sheet adhere firmly at all points. Any that may have pulled away before the cement has had a chance to set should be re-cemented.

VIII. ASPHALT SIDINGS

Asphalt materials are used for sidings in two forms, as roll products and as shingles. Roll materials are mineral surfaced, and embossed to simulate both brick and stone. Shingles may be either strip type or individual.

These products may be applied on new wall surfaces or over old materials when remodeling. Certain precautions must be observed in preparing the surface to receive the sidings if the products are to perform most effectively for the greatest length of time.

1. PREPARATION OF NEW WALL SURFACE

Any surface intended to be covered with asphalt siding should have the following general characteristics:

It should be reasonably smooth.
It should have suitable nail holding power.
It should be dry when the asphalt siding is applied.

(a) Wood Sheathing

All sheathing should be not less than 1" (nominal) thick and not more than 8" wide. Six inch width is preferred.

It shall be well seasoned, containing not more than 17% moisture. Green or unseasoned sheathing or recently stripped form lumber should not be used. Boards containing an excessive number of solid or loose knots or pitchy and resinous areas are undesirable, and badly warped boards should be rejected. Lumber should be protected from excessive wetting by rain, snow, condensation, or by contact with damp earth.

Sheathing should be milled to uniform standard thickness and dressed on at least one side. Edges should be either tongue and groove or shiplap. Square edge boards dressed on both edges may be used but are not as satisfactory.

(b) Application of Sheathing

Sheathing should be erected so that all edges and end joints are snugly fitted. The ends of all boards must occur over a stud, and end joints should be staggered in adjacent courses.

Each sheathing board should be nailed solidly to each stud it intersects with not less than two 8-penny nails, preferably cement coated. Matched and shiplapped sheathing should be nailed by the edge and face method.

The maximum center spacing between studs should be 24".

(c) Protection of Sheathing

The sheathing must be dry at the time the siding is applied. As soon as it is applied, the sheathing should be covered with asphalt saturated felt or building paper laid horizontally. The upper felt course should overlap the lower course 2" and where ends meet the lap should be 4".

(d) Other Materials

Other sheathing materials should be of a type recommended for the purpose and applied according to the specifications prepared by the manufacturer thereof.

2. PREPARATION OF EXISTING WALL SURFACES

Wall surfaces most commonly involved in residing work are -

a. Old wood shingles or siding.
b. Old asphalt shingles or sidings.
c. Old stucco applied over wood sheathing.

In each case the recommendations for preparing the surface are as follows:

(a) Old Wood Shingles or Siding

(1) Renail all loose siding or shingles securely. Pull loose nails and drive new nails in new locations. Replace badly damaged, knotted or missing portions of the siding material with sound material of the same style and size.

(2) Fill to the general plane of the wall surface with bevelled wood strips or lath and cover it with No. 15 Asphalt Saturated Felt, lapping the upper over the lower courses 2" and the ends of adjacent strips 4". Nail the felt sufficiently to hold it in place until the new siding material is applied over it.

(3) To provide a smooth surface to receive the siding a rigid asphalt backerboard may be applied in place of the bevelled wood "feathering strips", if desired. They should be secured with a row of nails 1" in from the edges of the units on 12" centers except at the ends and along the top and bottom edges of the walls, where the nails should be 6" apart.

(b) Old Asphalt Shingles or Siding

(1) Pull all loose and protruding nails, and nail down tightly or cut away all loose, curled or lifted material.

(2) Fill in with asphalt material areas where the old material is missing.

(3) Inspect the wall as the work progresses, and replace with sound materials those areas where rotted sheathing is found or where nail holding power is deficient.

(c) Old Stucco Applied Over Wood Sheathing

(1) Remove the stucco, stucco lath, building paper and all protruding nails.

(2) Replace rotted or defective sheathing with sound material and firmly renail all loose and warped sheathing.

(3) Apply horizontally No. 15 Asphalt Saturated Felt lapping and nailing as described above for wood shingles and siding.

APPLICATION OF ROLL BRICK SIDING

1. GENERAL

General Recommendation 1-a, Page 58, for handling roll roofing, and 1-a on Page 65 for split sheet products should be followed in the case of roll brick siding.

The material should be dry when applied and should be applied to a dry surface.

(a) Nails

Use non-corrodible nails with checkered or smooth heads (0.250" diameter) long enough to penetrate 3/4" into the wall surface to which the material is applied. Nail heads should be colored to match the siding material through which they are driven. This usually calls for black-headed nails at the mortar joints and other appropriate color for face nailing.

2. APPLICATION

(a) Chalk Lines

Snap a horizontal chalk line around the building at a distance above the lower edge of the prepared wall surface equal to 1/4" less than the width of one course of siding. As the work progresses, space additional chalk lines up the wall at intervals equal to the amount each course is exposed, for checking purposes.

Vertical chalk lines should be used on each side of windows and other openings to insure proper alignment of vertical mortar joints.

(b) First Course

Square off a strip of siding through a vertical mortar joint. Set the end even with a corner, and the top edge even with the first horizontal chalk line. Secure it with enough roofing nails along the selvage edge to hold it in place, and face nail with appropriate color-coated nails at the points indicated in Fig. 63 and as described in paragraph headed "Nailing" on Page 82.

(c) Second and Succeeding Courses

Second and succeeding courses are placed so that the top of each strip is on a horizontal chalk line. When properly spaced, this strip will lap the course next below by the amount of the selvage

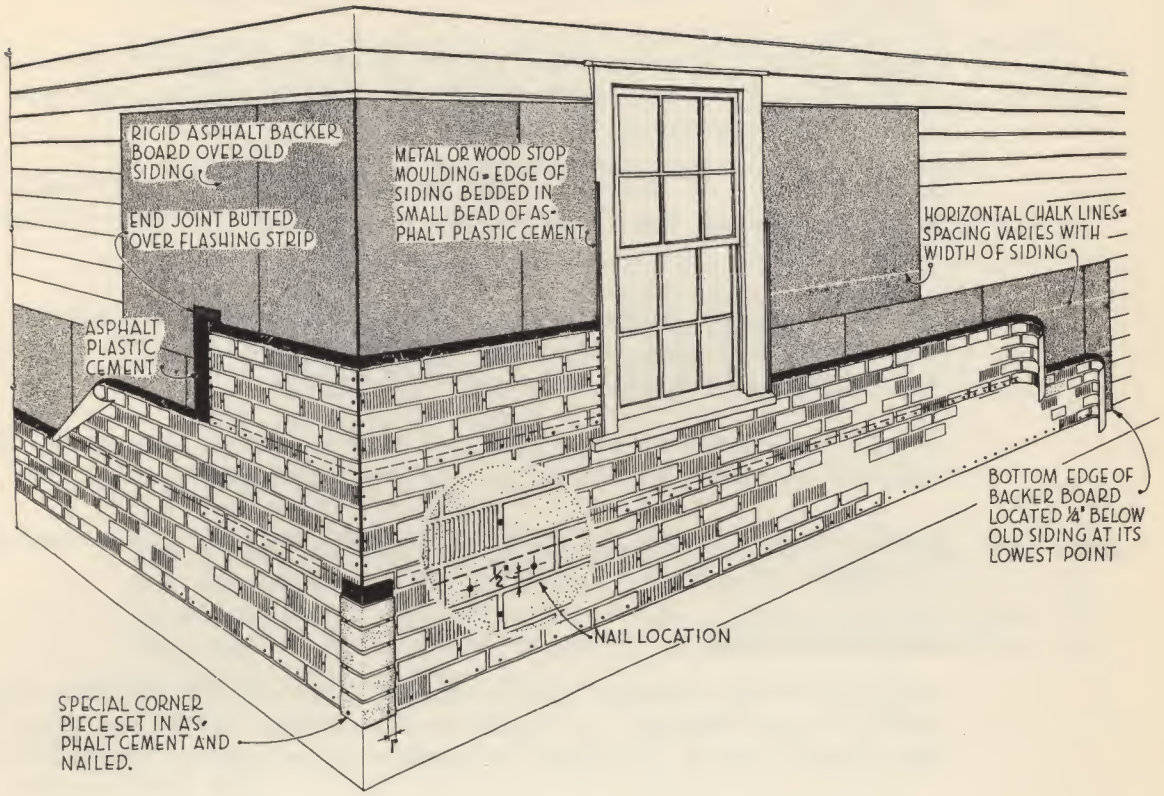


Fig. 63 - Application of Asphalt Roll Brick Siding - corner, trim, end joint, and nailing details.

less the width of one mortar joint. Broken "brick" joints are maintained by aligning the centers of the bricks in the lower row of the overlying course with the vertical mortar joints between bricks in the top row of the underlying course, the alignment being further checked with the vertical chalk lines. Nails are placed at points and with the type of nail as specified under "Nailing", Page 82.

(d) End Joints

Adjoining edges of meeting strips are cut and butted along a line passing through vertical mortar joints in the upper, middle and lower brick courses and through the center of the scored bricks in the second and fourth courses.

A flashing strip of No. 15 Asphalt Saturated Felt 6" wide and as long as the height of the course, set to overlap the selvage edge of the course below, is centered behind each butted joint. Note the end joint detail, Fig. 63. Before nailing, the siding strip is secured to the flashing strip with asphalt cement recommended by the manufacturer.

(e) Nailing

Nails along the horizontal lapped edges are located in a line 1/2" above the lower edge of the overlying course, and are spaced approximately 4" apart.

Along the top of the walls the nails are located 1/2" below the top edge of the final course and spaced the same distance apart, 4".

At the vertical joints, at inside corners, and at windows, doors, and other openings, nails are located in a line 1/2" from the cut edge of the strip and spaced 2" apart.

A nail is placed in each vertical mortar joint throughout the siding, as shown in the detail of nail placement, Fig. 63.

Avoid driving nails too tightly. Tight nailing has a tendency to create an uneven (quilted) effect.

(f) Outside Corners

Outside corner pieces, manufactured to match the siding, are used at the corners, as shown at the corner detail in Fig. 63. The corner piece is bedded in cement of a type recommended by the manufacturer. Care must be exercised to avoid using so much cement that the excess will ooze out along the edge of the strip when it is nailed. Nails are placed in each mortar line 1" in from the edge of the strip on both sides of the corner.

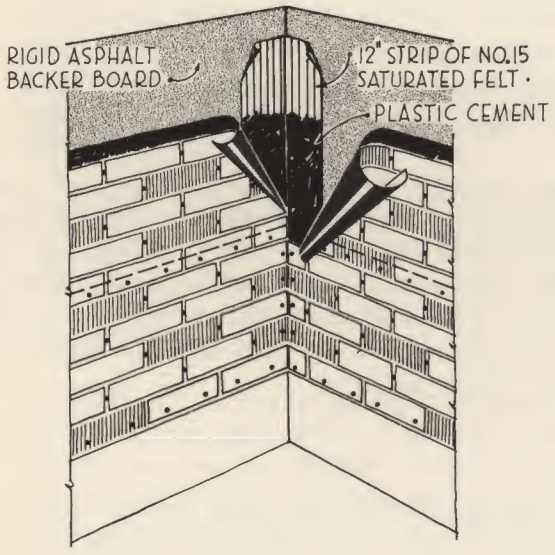


Fig. 64 - Inside Corner Detail

(g) Inside Corners

At inside corners a 12" wide flashing strip of No. 15 Asphalt Saturated Felt, long enough to overlap the selvage edge of the underlying course is bent into the angle at each course, as shown in Fig. 64. The siding strips are cut to fit snugly in the corner, and the ends are bedded in asphalt cement applied to the flashing strip before nailing.

(h) Windows, Doors and Other Openings

(1) Where the wood trim around the opening protrudes beyond the face of the wall surface on which the siding is being applied, the siding is cut to fit against the edge of the trim and under the window sills, and is embedded in a narrow bead of asphalt cement before being nailed.

(2) Where the wood trim around the opening is flush with the old siding material or underlying backer board, as in Fig. 63, either a narrow wood moulding or a special metal stop, manufactured for the purpose, is applied to the trim 1" in from its edge, and the siding is butted snugly against it. Before nailing, the siding is embedded in a narrow bead of asphalt cement.

(i) Finish at Top of Wall

The siding is carried to the top of the wall and embedded along its top edge in asphalt cement in a manner appropriate to the construction of the eaves and rake. It is important that the top edge of the uppermost course be protected from direct exposure to the weather.

APPLICATION OF GIANT INDIVIDUAL SIDING SHINGLES

1. GENERAL

Before starting to apply siding shingles it is important that the wall surface be properly prepared, as described on Pages 77 to 79.

2. NAILS

(a) Type

Either non-corrodible nails with checkered heads, or common galvanized roofing nails long enough to penetrate at least 3/4" into the wall surface, are recommended for concealed locations. Exposed nails should preferably have heads colored to match the shingles.

(b) Number and Location

There are two methods of nailing commonly used. The method described and illustrated herein indicates that, except for the shingles in the starter course, which require two exposed nails, each shingle is secured with three nails, one concealed and two exposed. The concealed nail is centered on the shingle 1/2" down from its top edge, and the exposed nails are placed, one in each corner, 1" in from the side and 1-1/2" above the lower edge.

The other method calls for 4 nails, two concealed and two exposed. The concealed nails are placed one on each side of the shingle, 1" in from the side and approximately 8" above the bottom edge. The exposed nails are placed as described for the three-nail method. This second method of placing concealed nails is required when plastic cement is used in place of the exposed nails as is sometimes done.

3. APPLICATION

(a) Chalk Lines

A horizontal chalk line is snapped around the building at a height above the lowest point of the old siding or backing equal to the length of a shingle less 1/4". This will insure that when the shingles are set to this line they will extend at least 1/4" below the bottom edge of the prepared wall surface. Other horizontal chalk lines are placed at intervals up the wall equal to the pre-determined exposure of the shingles for checking the alignment of subsequent courses.

Vertical chalk lines are snapped along each side of wall openings, perpendicular to the lower horizontal chalk lines at intervals which will maintain the correct spacing of the shingles.

(b) Outside Corners

At each outside corner a metal corner bead manufactured for the purpose is applied. If the corner is not plumb, a vertical plumb line is snapped alongside the corner bead to serve as a guide in adjusting the width of the starting shingles of each course.

At each succeeding corner after the first, a better appearance will result if the width of the finishing shingle portion in each course is equal to the width of the starting shingle portion in the same course on the adjacent intersecting wall.

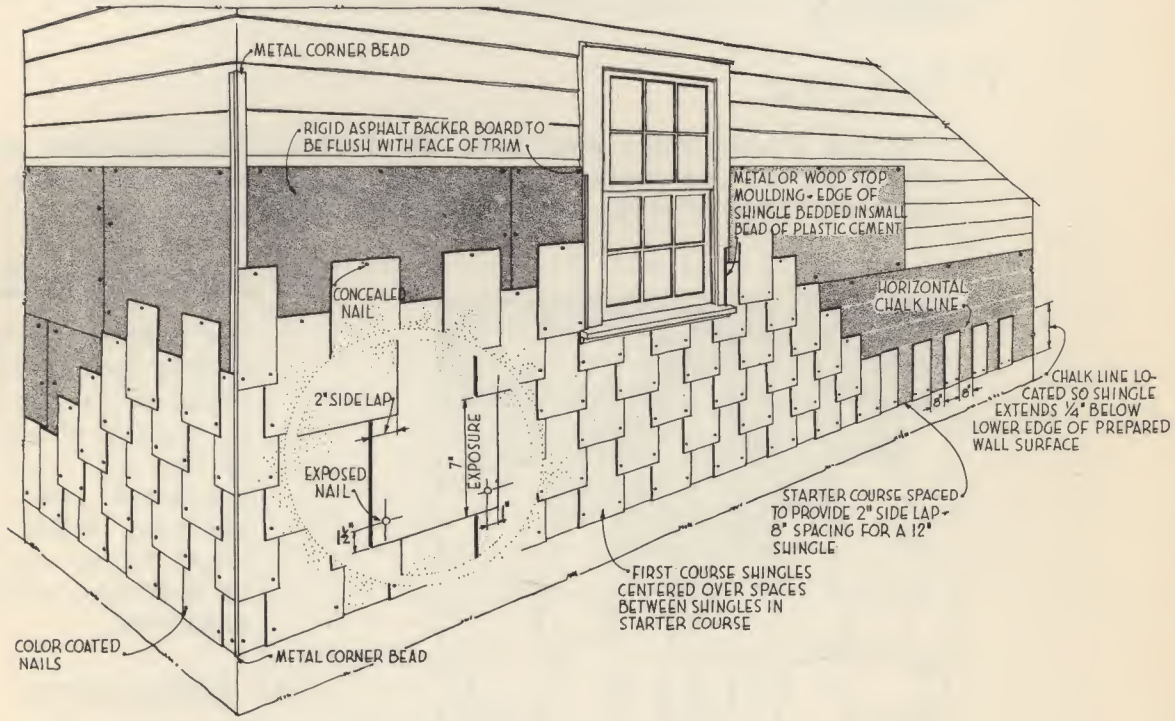


Fig. 65 - Application of Giant Individual Shingles to Side Walls by the Wide Space Method.

(c) Starter Course

The starter course consists of shingles spaced at intervals which will provide for a side lap by the overlying (first course) shingles of not less than 2". For a 12" wide shingle, the space between shingles will be 8". At the first outside corner, the course begins with a half shingle, the cut edge of which is set into the moulded recess of the corner bead. The first and all succeeding shingles in the course are lined even with the first horizontal chalk line and each is secured with 2 nails, one located 1" in from each side high enough to insure solid nailing.

(d) First Course

The first course consists of full size shingles centered over the spaces between shingles in the starter course and at the same level. Each shingle is secured with one concealed and two exposed nails, as shown in Fig. 65, and specified in 2 (b) above.

(e) Second Course

The second course begins with a half shingle, adjusted to and laid against the corner bead at a height above the first course equal to the predetermined exposure. Full shingles are thereafter applied along the wall, spacing them so they come above the starter course shingles, and securing them with nails as specified.

(f) Third Course

Starting a half space away from the corner, full shingles are centered over the spaces between the shingles in the course below and secured with nails in the manner specified.

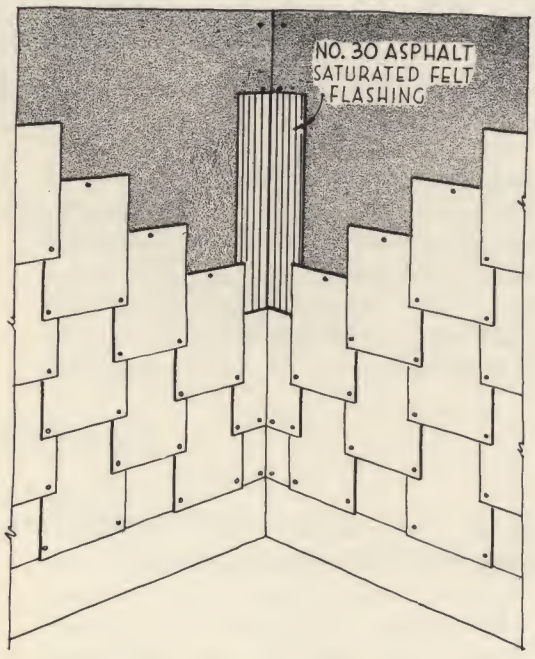


Fig. 66 - Inside Corner Detail

(g) Succeeding Courses

The second and third course specifications are repeated in regular sequence up the wall, both horizontal and vertical chalk lines being used to maintain proper alignment.

(h) Inside Corners

A 12" wide flashing strip of No. 30 Asphalt Saturated Felt is centered in each inside corner, as shown in Fig. 66, and shingles are cut to fit snugly in the corner over it.

(i) Doors, Windows and Other Openings

1. If the trim around wall openings is flush with the old siding or backerboard as shown in Fig. 65, either a narrow wood moulding or a special metal stop moulding is applied 1" in

from the outside trim edge and the shingles are butted tightly against it, the edges being bedded in a narrow bead of plastic cement or caulking compound.

2. If the trim projects beyond the face of the prepared wall surface, the end shingles are cut to fit against the edge of the trim and under window sills. Asphalt plastic cement is used under the joint between the shingles and the trim.

(j) Finish at the Top of the Wall

The shingles are applied up to the top of the wall, and the top edges of the last course are embedded in asphalt plastic cement in a manner appropriate to the construction of the eaves or rakes. It is important that the top edge of the uppermost course be protected from direct exposure to the weather.

IX. COVERAGE

1. GENERAL

"Coverage" of asphalt roofings is a term applied to indicate roughly the amount of weather protection provided by the different products. Asphalt Roll Roofings are generally considered to be single coverage items because they provide but a single layer of material over the greater part of the roof area. On the other hand, shingles, both single and multiple types, are small units laid so that they overlap each other to a greater or less extent depending upon their shape and prescribed method of application. Therefore, they furnish one, two, three and sometimes four plies or thicknesses of fabric over different areas of roof. Those whose coverage is such that nowhere is there any roof area with less than two thicknesses are termed "double coverage". Those that provide not less than three thicknesses for any significant proportion of the roof area are termed "triple coverage."

The relation of coverage to waterproofness is obvious. Triple coverage roofings may be weathered to the extent that the surface granules and asphalt coatings are practically all gone, yet the roof will remain sound because of the unweathered layers underneath the surface, and to a somewhat lesser extent this is true also of double coverage roofings. Single coverage roofings usually are used satisfactorily for reroofing over old materials, in effect providing a new surface for an old roof that is still serviceable except for isolated trouble spots. Double and triple coverage materials are the best to use for new construction for obvious reasons. Though they have highest first cost, providing more material per square, they are longer lived and have greater fire resistance than do the reroofing types. It is probable that the annual cost of a roof on a new building considered both from the investment and from the maintenance standpoints will be less with the multiple coverage than with the single coverage materials.

2. COVERAGE PATTERNS

Coverage is determined on the basis of patterns which repeat themselves over the roof. Coverage patterns are illustrated in Figs. 67 to 72 for the common styles of shingles. In each case the white areas are those covered by only one thickness of material. The lightly shaded areas are covered by two thicknesses, the heavily shaded areas by three, and the black areas by four.

A rough comparison between the styles of roofing is reflected in the tone of the coverage patterns. The darker the over-all tone, generally speaking, the more material is provided per unit of roof area, and therefore the longer the roofing should be expected to resist weathering. These darker toned patterns represent materials that are good to use in new construction. The lighter toned patterns are for roofing styles best adapted to reroofing over old materials.

Roof Deck Covered by	Percent
2 Ply (Light Shade)	15.25
3 Ply (Heavy Shade)	68.27
4 Ply (Black)	16.48
Total	100.00

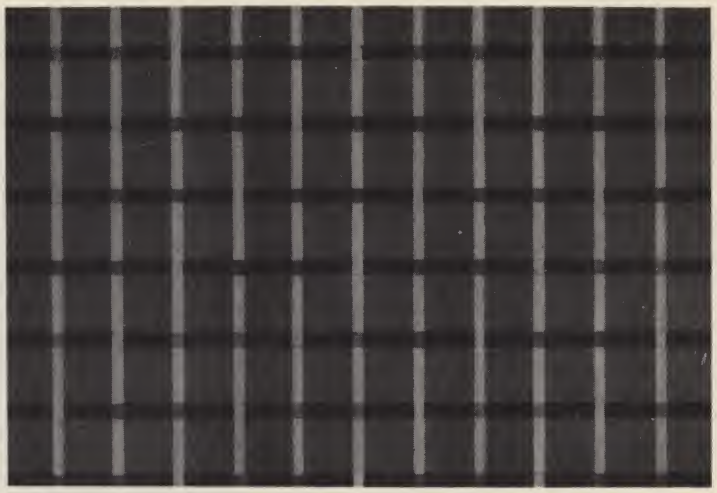


Fig. 67 - Giant Individual-American method. Joints break in thirds.

Roof Deck Covered by	Percent
1 Ply (White)	4.7
2 Ply (Light Shade)	1.2
3 Ply (Heavy Shade)	75.3
4 Ply (Black)	18.8
Total	100.0

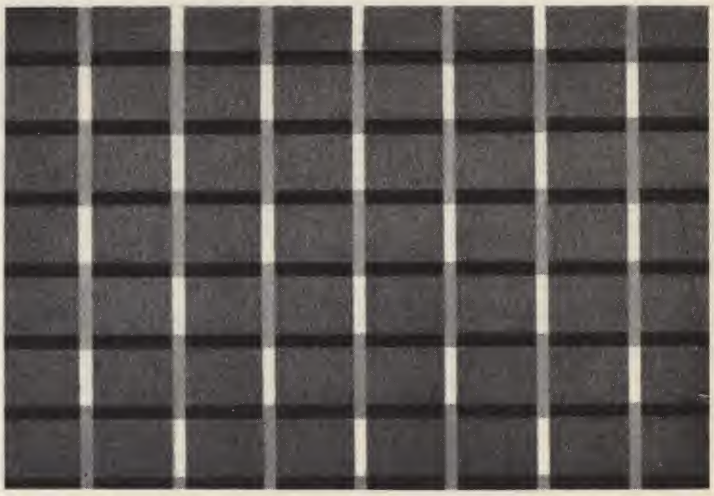


Fig. 68 - Giant Individual-American method. Joints break in half.

Roof Deck Covered by	Percent
1 Ply (White)	2.0
2 Ply (Light Shade)	59.0
3 Ply (Heavy Shade)	39.0
Total	100.0

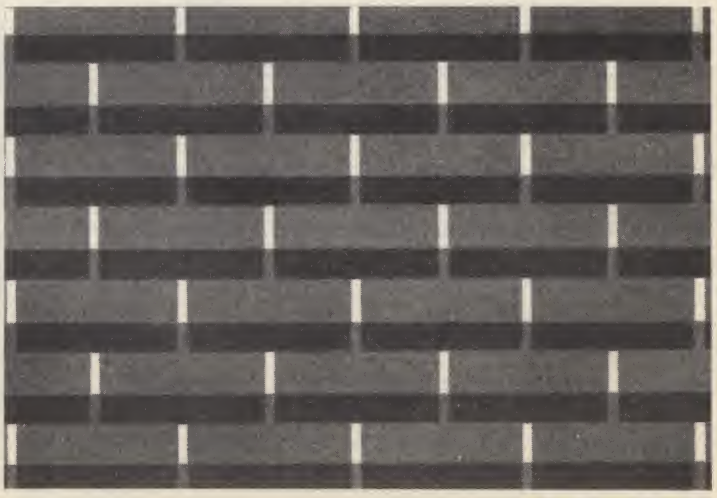


Fig. 69 - Three tab square butt strip.

Roof Deck Covered by	Percent
1 Ply (White)	24.6
2 Ply (Light Shade)	58.0
3 Ply (Heavy Shade)	17.4
Total	100.0

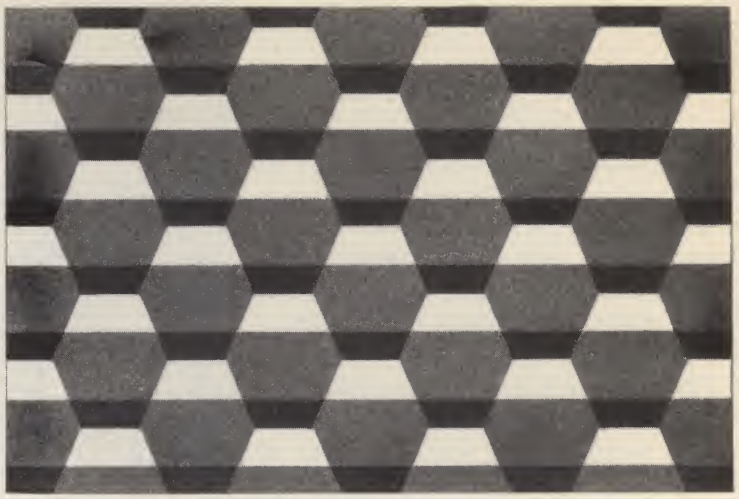


Fig. 70 - Three tab hex strips.

Roof Deck Covered by	Percent
1 Ply (White)	61.3
2 Ply (Light Shade)	29.3
3 Ply (Heavy Shade)	9.4
Total	100.0

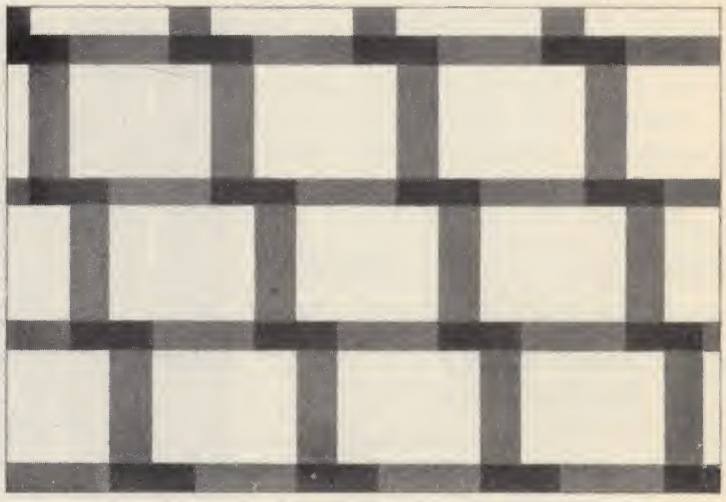


Fig. 71 - Giant Individual Dutch lap.

Roof Deck Covered by	Percent
1 Ply (White)	68.5
2 Ply (Light Shade)	24.0
3 Ply (Heavy Shade)	7.5
Total	100.0

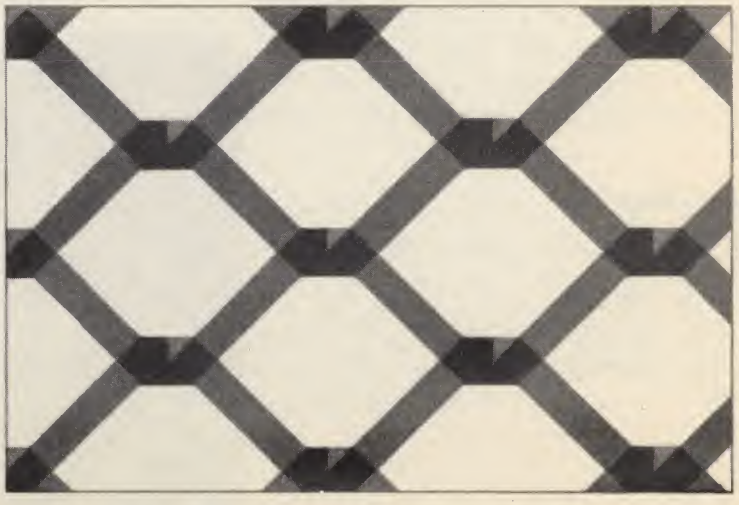


Fig. 72 - Individual hex shingle - staple down type.

X. THE UNDERWRITERS LABORATORIES' SERVICE TO THE ROOFING INDUSTRY

All Asphalt Roofing Products with the exception of 45 lb. (or lighter) roll roofings have been tested and approved by the Underwriters' Laboratories as qualifying for their "C" label or classification. This identifies them as being "effective against light fire exposure", that is, they are "not readily flammable and do not readily carry or communicate fire; afford at least a slight degree of heat insulation to the roof deck; do not slip from position; possess no flying brand hazard; and may require occasional repairs or renewals in order to maintain their fire-resisting properties."

This means exactly what it says, no more and no less. From a practical service standpoint it means that these roofings act to inhibit the spread of fire from one building to another. In many urban communities roofing materials that are more flammable than asphalt products, that do not qualify for the Class "C" label, have been prohibited for use within certain prescribed areas. Asphalt Roofing Products have never been so prohibited. Thus, the Class "C" label is indicative of acceptability of Asphalt Roofing Products from the standpoint of fire protection in any community.

An understanding of what the Underwriters' Laboratories, Inc. is, will help to indicate the significance of this classification, and to point up what it means to the distributor and consumer of goods so labeled.

Underwriters Laboratories, Inc., was founded in 1894, under the sponsorship of the National Board of Fire Underwriters, as a non-profit organization without capital stock, to establish, maintain, and operate laboratories for the examination and testing of devices, systems, and materials.

Not only will it test a material to determine its resistance to fire, but it will also set up minimum manufacturing specifications to which the manufacturer must conform in order to remain eligible to use the label on his goods. The Laboratories maintain a check on a labelled product by factory inspections at regular intervals. Their engineers are afforded the privilege of the manufacturers' control laboratories and periodically visit, inspect, or analyze samples of the product, thereafter reporting their findings to the Underwriters. If necessary, they will recommend to the manufacturer measures which in their judgment are required to maintain the standard of the product.

Under these circumstances it is fairly obvious that when a package of roofing bears the Underwriters' Label "C", the material therein can be accepted as capable of performing within the limits set forth in detail in paragraph one above.

XI. HOW TO ESTIMATE QUANTITIES OF ROOFING

Roofing is estimated and sold in squares. A square of roofing is the amount required to cover 100 square feet of roof area. In order to estimate the amount required for any given roof it is necessary to compute the total area to be covered in square feet, to divide this amount by 100 and then to add a certain percentage for waste and cutting. The percentage to add must be determined by each individual according to his own experience. A good general average is 10 percent. A simple roof, uncomplicated by dormers or other irregularities such as are illustrated in Fig. 77 will require less, while the complicated roofs will require more.

Estimating Area

The areas of simple surfaces, rectangular in shape, or made up of rectangular elements, can be computed easily. The area of the shed roof, Fig. 73, is the product of the eave line and the rake line, A x B. The area of the simple gable roof, Fig. 73, equals the sum of the two rakes,

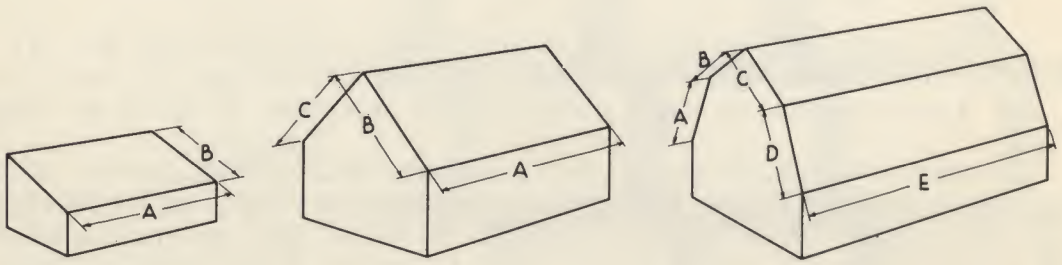


Fig. 73 - Simple Roof Types

B and C, multiplied by the eave line A. Likewise, the gambrel roof, Fig. 73, is estimated by multiplying the sum of the rake lines A, B, C & D by the eave line E.

But when ells and gables or dormers enter the problem as in Fig. 77 on Page 94 complications arise. The lengths of eaves, rakes, valleys and ridges can be easily obtained only from drawings or sketches. The simple methods described above cannot be followed without laboriously and perhaps dangerously climbing over the roof to measure the necessary distances directly.

The method described in the following pages has been worked out to enable the estimator to determine the areas to be roofed without climbing on the roof and without going through a long series of complicated computations. The method requires that:

1. The pitch of the roof be known or determined.
2. The horizontal area in square feet covered by the roof be computed.

Pitch - The span, rise and run of a simple gable roof are shown in Fig. 74. The pitch or slope of the roof is most often stated as the relation between the rise and the span. If the span is 24'0" and the rise is 8'0" the pitch will be 8/24 or 1/3. If the rise were 6'0" then the pitch would be 6/24 or 1/4. The 1/3 pitch roof rises 8" per foot of horizontal run, and the 1/4 pitch roof rises 6" per foot of run.

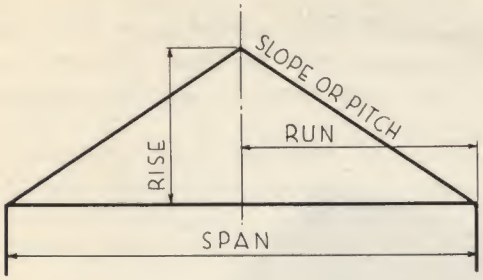


Fig. 74 - Pitch relations

It is possible to determine the pitch of any roof without leaving the ground by using a carpenter's folding rule in the following manner.

Form a triangle with the rule. Stand across the street or road from the building, and holding the rule at arms length, align the roof slope with the sides of the rule, being sure that the base of the triangle is held horizontal. It will appear within the triangle as in Fig. 75. Take a reading on the base section of the rule (note the "reading point", Fig. 75).

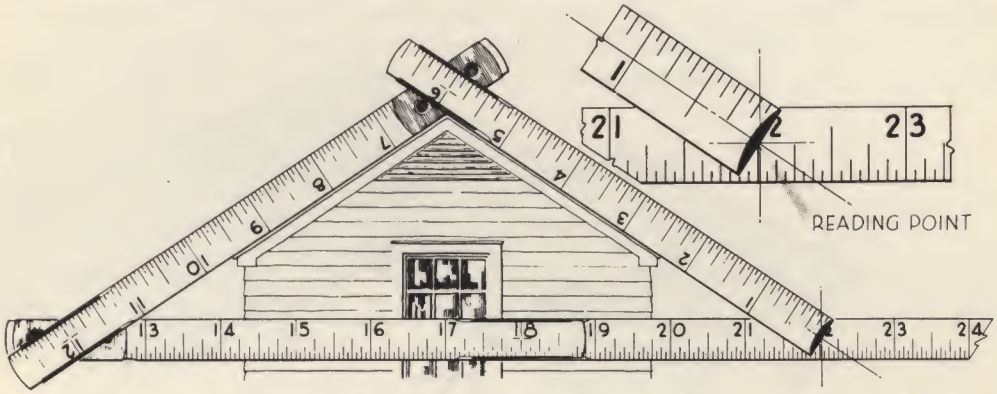
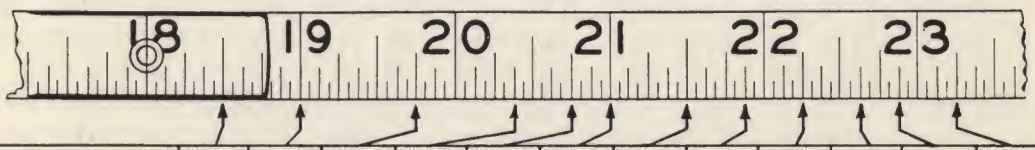


Fig. 75 - Use of Carpenters' Rules to Find Roof Pitch.

Then locate on Fig. 76 in the top line headed "Rule Reading" the point nearest your reading. Below this point will be found the pitch and the rise per foot of run. In the case illustrated the reading is 22 and the nearest point in Fig. 76 is 21-7/8, indicating the pitch to be 8" rise per foot of run.



RULE READING		18½	19	19¾	20⅜	20¾	21	21½	21⅞	22¼	22⅝	22⅞	23¼
PITCH	DEGREES	56°19'	53°8'	49°24'	45°	42°31'	39°48'	36°52'	33°41'	30°16'	26°34'	22°37'	18°26'
	FRACTIONS	3/4	2/3	7/12	1/2	11/24	5/12	3/8	1/3	7/24	1/4	5/24	1/6
RISE	INCHES PER FT. OF HORIZ. RUN	18"	16"	14"	12"	11"	10"	9"	8"	7"	6"	5"	4"

Fig. 76 - Reading Point converted to pitch.

Horizontal Area

Fig. 77 shows a typical dwelling having a roof complicated by valleys, dormers and variable height ridges. The projection below the perspective shows the total ground area (horizontal surface) covered by the roof. All measurements needed to draw such a horizontal projection, or roof plan, can be made from the ground or within the attic space of the house. No climbing on the roof is necessary.

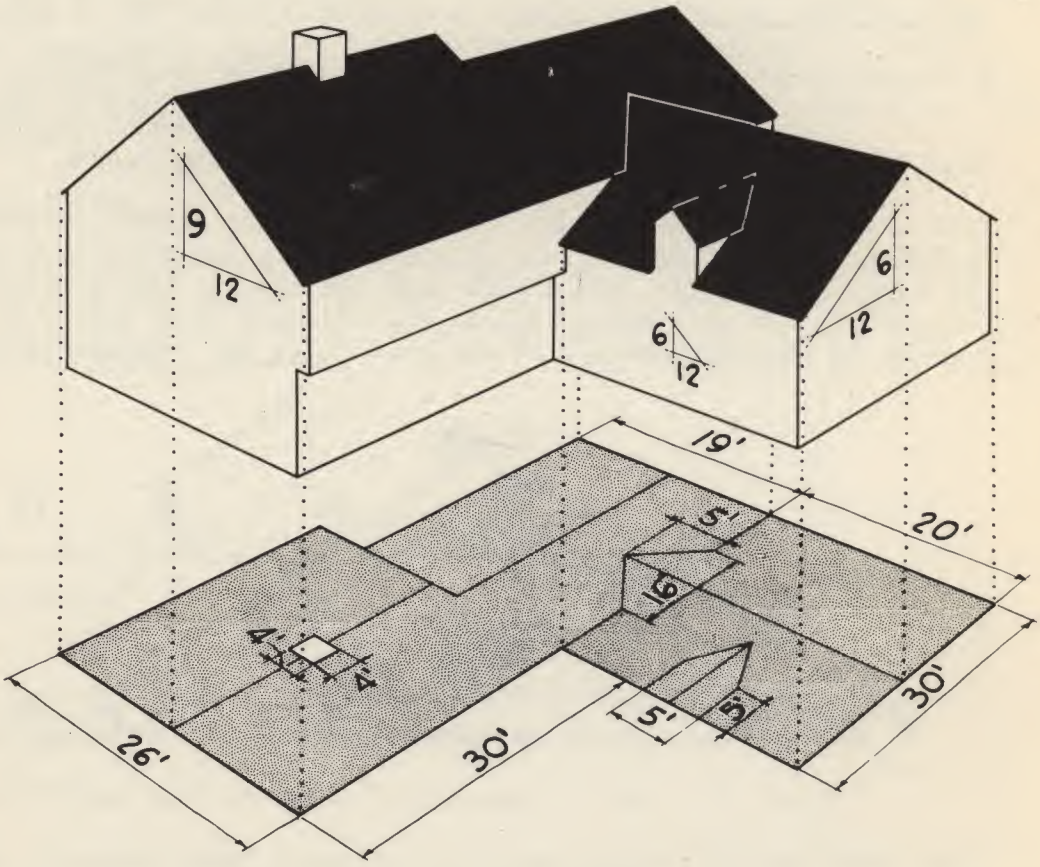


Fig. 77 - Typical Dwelling Roof Shown in Perspective and Plan.

Computation of Roof Areas

After all measurements have been made and a roof plan drawn, and after the pitches of the various elements of the roof have been determined with the carpenters' rule (or pitch card), the horizontal areas can be quickly worked out. In each estimate only those areas are included which come under elements of the roof having the same pitch. The rise of the main roof is 9" per foot, while that of the ell and dormers is 6" per foot.

The horizontal area under the 9" slope roof will be:

	26 x 30	= 780	square feet
	19 x 30	= 570	" "
	Total	=1350	" "
Less	8 x 5	= 40	(triangular area under ell roof)
	4 x 4	= 16	(chimney)
		=1294	square feet

The area under the 6" rise roof will be -

20 x 30 = 600 square feet
8 x 5 = 40 (triangular area projecting over the main house)
Total = 640

Duplications

Sometimes one element of a roof projects over another. Such duplicated areas should be added to the total horizontal area. If the eaves in Fig. 77 project only 4" there will be, (1) a duplication under the dormer eaves of 2 (5 x 1/3) or 3-1/3 sq.ft.; (2) a duplication of 2 (7 x 1/3) or 4-2/3 sq.ft. under the eaves of the main house where they overhang the rake of the Ell section; and (3) a duplication of $9\frac{1}{2}$ x 1/3 or 3-1/6 sq.ft. under the eaves of the wide section of the main house where it overhangs the rake of the small section in the rear. The total is 11-1/6 or 12 sq.ft.

Item (1) should be added to the area of the 6" pitch roof and Items (2) and (3) to the 9" pitch roof. The new totals will be 640 + 4 or 644 for the 6" pitch and 1294 + 8 or 1302 for the 9" pitch.

It now remains to convert horizontal areas to slope areas. This is done with the aid of the Conversion Table below. Horizontal areas are given in the first column, while corresponding slope areas are given in colums 2 to 12.

TABLE IV - CONVERSION TABLE

RISE {Inches per foot of horizontal run}	4"	5"	6"	7"	8"	9"	10"	11"	12"	14"	16"	18"
PITCH {Degrees}	18° 26'	22° 37'	26° 34'	30° 16'	33° 41'	36° 52'	39° 48'	42° 31'	45°	49° 24'	53° 8'	56° 19'
{Fractions}	1/6	5/24	1/4	7/24	1/3	3/8	5/12	11/24	1/2	7/12	2/3	3/4
CONVERSION FACTOR	1.054	1.083	1.118	1.157	1.202	1.250	1.302	1.356	1.414	1.537	1.667	1.803
HORIZONTAL (Area in Sq. Ft. or Length in Feet)												
1	1.1	1.1	1.1	1.2	1.2	1.3	1.3	1.4	1.4	1.5	1.7	1.8
2	2.1	2.2	2.2	2.3	2.4	2.5	2.6	2.7	2.8	3.1	3.3	3.6
3	3.2	3.2	3.4	3.5	3.6	3.8	3.9	4.1	4.2	4.6	5.0	5.4
4	4.2	4.3	4.5	4.6	4.8	5.0	5.2	5.4	5.7	6.1	6.7	7.2
5	5.3	5.4	5.6	5.8	6.0	6.3	6.5	6.8	7.1	7.7	8.3	9.0
6	6.3	6.5	6.7	6.9	7.2	7.5	7.8	8.1	8.5	9.2	10.0	10.8
7	7.4	7.6	7.8	8.1	8.4	8.8	9.1	9.5	9.9	10.8	11.7	12.6
8	8.4	8.7	8.9	9.3	9.6	10.0	10.4	10.8	11.3	12.3	13.3	14.4
9	9.5	9.7	10.1	10.4	10.8	11.3	11.7	12.2	12.7	13.8	15.0	16.2
10	10.5	10.8	11.2	11.6	12.0	12.5	13.0	13.6	14.1	15.4	16.7	18.0
20	21.1	21.7	22.4	23.1	24.0	25.0	26.0	27.1	28.3	30.7	33.3	36.1
30	31.6	32.5	33.5	34.7	36.1	37.5	39.1	40.7	42.4	46.1	50.0	54.1
40	42.2	43.3	44.7	46.3	48.1	50.0	52.1	54.2	56.6	61.5	66.7	72.1
50	52.7	54.2	55.9	57.8	60.1	62.5	65.1	67.8	70.7	76.9	83.4	90.2
60	63.2	65.0	67.1	69.4	72.1	75.0	78.1	81.4	84.8	92.2	100.0	108.2
70	73.8	75.8	78.3	81.0	84.1	87.5	91.1	94.9	99.0	107.6	116.7	126.2
80	84.3	86.6	89.4	92.6	96.2	100.0	104.2	108.5	113.1	123.0	133.4	144.2
90	94.9	97.5	100.6	104.1	108.2	112.5	117.2	122.0	127.3	138.3	150.0	162.3
100	105.4	108.3	111.8	115.7	120.2	125.0	130.2	135.6	141.4	153.7	166.7	180.3
200	210.8	216.6	223.6	231.4	240.4	250.0	260.4	271.2	282.8	307.4	333.4	360.6
300	316.2	324.9	335.4	347.1	360.6	375.0	390.6	406.8	424.2	461.1	500.1	540.9
400	421.6	433.2	447.2	462.8	480.8	500.0	520.8	542.4	565.6	614.8	666.8	721.2
500	527.0	541.5	559.0	578.5	601.0	625.0	651.0	678.0	707.0	768.5	833.5	901.5
600	632.4	649 8	670.8	694.2	721.2	750.0	781.2	813.6	848.4	922.2	1000.2	1081.8
700	737.8	758.1	782.6	809.9	841.4	875.0	911.4	949.2	989.8	1075.9	1166.9	1262.1
800	843.2	864.4	894.4	925.6	961.6	1000.0	1041.6	1084.8	1131.2	1229.6	1333.6	1442.4
900	948.6	974.7	1006.2	1041.3	1081.8	1125.0	1171.8	1220.4	1272.6	1383.3	1500.3	1622.7
1000	1054.0	1083.0	1118.0	1157.0	1202.0	1250.0	1302.0	1356.0	1414.0	1537.0	1667.0	1803.0

Table IV - For converting horizontal distances or areas to slope distances or areas.

Procedure for Converting Horizontal to Slope Areas

Opposite the figure in the column headed "horizontal" find the slope area in the column under the pitch involved.

The total area under the 9" rise is 1302 square feet.

Under the column headed "9" rise" on the conversion table is found:

	Horizontal Area	Slope Area
Opposite	1,000	1,250.0
"	300	375.0
"	00	00.0
"	2	2.5
Total	1,302	1,627.5

The total area under the 6" rise = 644 square feet

	Horizontal Area	Slope Area
Opposite	600	670.8
"	40	44.6
"	4	4.5
Total	644	719.9

The total area for both pitches will be 1,627.5 + 719.9 = 2,347.4 sq.ft.

To this should be added an appropriate percentage for waste, say 10%, which will bring the total area of roofing required to 2,582 sq.ft. or 26 squares.

One point in connection with this method should be particularly emphasized. The method is possible because of the fact that over any given horizontal area, at a given pitch, a roof will always contain the same number of square feet regardless of its design. Trial will show that a shed roof, a gable roof, or a hip roof with or without dormers, when placed over the same horizontal area with the same pitch, will each require exactly the same square footage of roofing.

Accessories

Quantities of starter strips, edging strip, ridge shingles, and valley strips all depend upon linear measurements along eaves, rake, ridge and valley. Eaves and ridge are horizontal. The rake and valley run on a slope. Quantities for the horizontal elements can easily be taken off the roof plan directly. The true length of rakes and valleys, however, must be taken from appropriate conversion tables.

Length of Rake

To determine the length of the rake of the roof, measure first the horizontal distance over which it extends. In the case under consideration (Fig. 77), the rake on the ends of the main house span distances of 26' and 19' respectively. Additional rake footage occurs also at the point where the higher roof section joins the lower. This amounts to 13 + $3\frac{1}{2}$. The total rake footage is therefore 26 + 19 + 13 + $3\frac{1}{2}$ = $61\frac{1}{2}$ ft.

By referring to Table IV under the 9" rise column, it is found that, opposite the figures in Column 1, which reads "Horizontal Area in Square Feet or Length in Feet":

	Horizontal Run	Length of Rake	
	60	75.0	
	1	1.3	
	.5	.6	
Total	61.5	76.9	actual length of rake

The same method applied to the rake of the ell indicates its length, including the dormer, to be 39.1'. When these amounts are added to the total length of eaves, a figure is obtained on which to base an estimate of the quantity of edging required.

Hips and Valleys

Length of hips and valleys can be determined if the run of the common rafter is known, and the Hip and Valley Table, (Table V) is used.

TABLE V - HIP AND VALLEY TABLE

RISE {Inches per foot of horizontal run}	4"	5"	6"	7"	8"	9"	10"	11"	12"	14"	16"	18"
PITCH {Degrees}	18° 26'	22° 37'	26° 34'	30° 16'	33° 41'	36° 52'	39° 48'	42° 31'	45°	49° 24'	53° 8'	56° 19'
{Fractions}	1/6	5/24	1/4	7/24	1/3	3/8	5/12	11/24	1/2	7/12	2/3	3/4
CONVERSION FACTOR.	1.452	1.474	1.500	1.524	1.564	1.600	1.642	1.684	1.732	1.814	1.944	2.062
HORIZONTAL (Length in Feet)												
1	1.5	1.5	1.5	1.5	1.6	1.6	1.6	1.7	1.7	1.8	1.9	2.1
2	2.9	2.9	3.0	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.9	4.1
3	4.4	4.4	4.5	4.6	4.7	4.8	4.9	5.1	5.2	5.4	5.8	6.2
4	5.8	5.9	6.0	6.1	6.3	6.4	6.6	6.7	6.9	7.3	7.8	8.2
5	7.3	7.4	7.5	7.6	7.8	8.0	8.2	8.4	8.7	9.1	9.7	10.3
6	8.7	8.8	9.0	9.1	9.4	9.6	9.9	10.1	10.4	10.9	11.7	12.4
7	10.2	10.3	10.5	10.7	10.9	11.2	11.5	11.8	12.1	12.7	13.6	14.4
8	11.6	11.8	12.0	12.2	12.5	12.8	13.1	13.5	13.9	14.5	15.6	16.5
9	13.1	13.3	13.5	13.7	14.1	14.4	14.8	15.2	15.6	16.3	17.5	18.6
10	14.5	14.7	15.0	15.2	15.6	16.0	16.4	16.8	17.3	18.1	19.4	20.6
20	29.0	29.5	30.0	30.5	31.3	32.0	32.8	33.7	34.6	36.3	38.9	41.2
30	43.6	44.2	45.0	45.7	46.9	48.0	49.3	50.5	52.0	54.4	58.3	61.9
40	58.1	59.0	60.0	61.0	62.6	64.0	65.7	67.4	69.3	72.6	77.8	82.5
50	72.6	73.7	75.0	76.2	78.2	80.0	82.1	84.2	86.6	90.7	97.2	103.1
60	87.1	88.4	90.0	91.4	93.8	96.0	98.5	101.0	103.9	108.8	116.6	123.7
70	101.6	103.2	105.0	106.7	109.5	112.0	114.9	117.9	121.2	127.0	136.1	144.3
80	116.2	117.9	120.0	121.9	125.1	128.0	131.4	134.7	138.6	145.1	155.5	165.0
90	130.7	132.7	135.0	137.2	140.8	144.0	147.8	151.6	155.9	163.3	175.0	185.6
100	145.2	147.4	150.0	152.4	156.4	160.0	164.2	168.4	173.2	181.4	194.4	206.2

Table V - For determining length of valleys and hips.

The run of the common rafter is 1/2 of the horizontal distance which the roof spans. When used to determine the length of a valley, the run of the common rafter should be taken at the lower end of the valley.

In Fig. 77 the portion of the ell roof which projects over the main roof has a span of 16' at the lower end of the valley, and therefore the common rafter at this point has a run of 8' - 0".

Since there are two valleys at this roof intersection the total run of the common rafter to be considered is 16' - 0". Refer now to the Hip and Valley Table. Opposite the figures in the column headed "Horizontal", find the lineal feet of valleys in the column under the pitch involved.

Since one of the intersecting roofs has a rise of 6" and the other a rise of 9", the length for each rise must be found and the average of the two taken. (This will give a very close approximation of the true length of the valley).

Thus - Horizontal	6" Rise	9" Rise
10	15	16.
6	9	9.6
16	24	25.6
		24.0
		2/49.6
		24.8 length of valleys

Dormer Valleys - The run of the common rafter at the dormer is 2.5 feet.

Entering the Hip and Valley Table it is found that:

Horizontal	6" Rise
2.0	3.0
.5	.75
2.5	3.75 length of valley

Two such valleys will total 7.5'.

The total length of valley will therefore be 24.8 + 7.5 = 32.3 feet.

These figures can be used to estimate the amount of flashing material that will be required.